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Factors Affecting Application of Motors to Lathes—Considerations Necessary in Selecting Insulators—and other engineering articles

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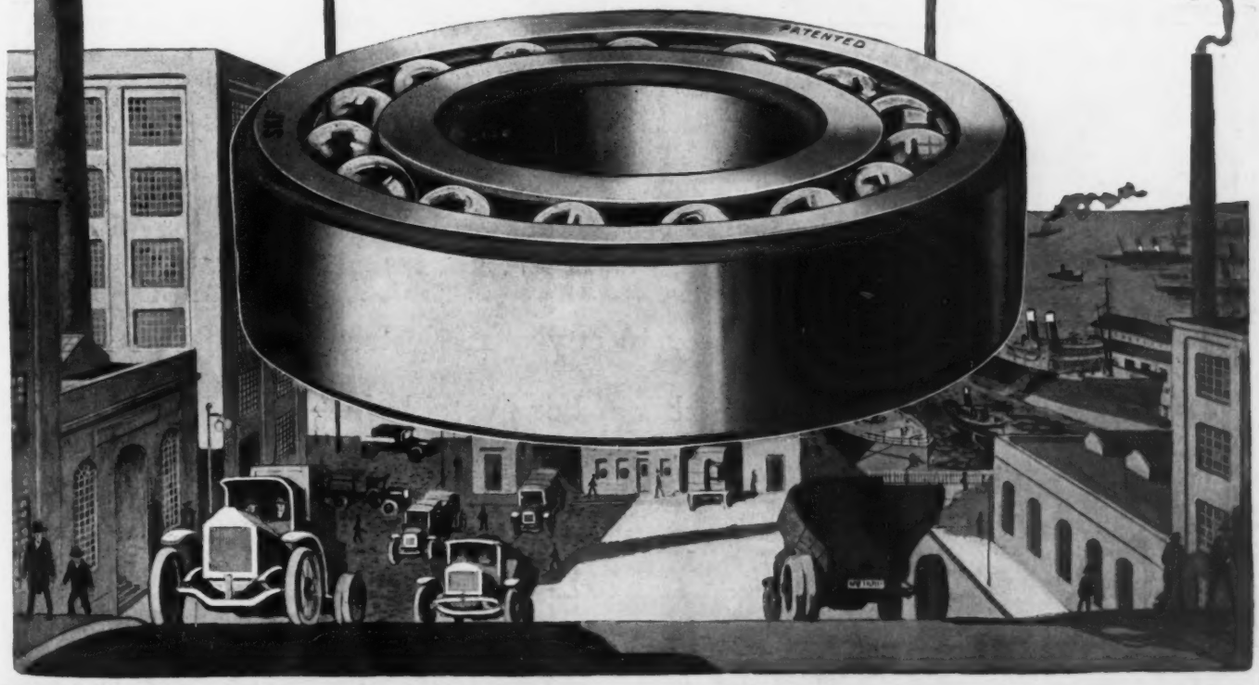

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Electrical World

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Honor to Whom Honor Is Due

OF THE 650,000,000 tons of coal which will be mined this year only 4 per cent represents the entire electric central station requirements of the country, the greater part of the electrical energy now used being generated in hydroelectric stations. By utilizing water power the central station industry conserves nature's resources, releases millions of tons of coal, the cars necessary to transport it and the labor required to mine it, while the coal it consumes, as the Fuel Administrator himself has graciously allowed, is burned most economically. In view of the wide publicity given to the sign-lighting orders which indirectly involve the electric lighting industry, it is well that these facts be constantly borne in mind. Fuel saving, however slight, is vitally necessary in the present world crisis, but we suggest that as a matter of self-interest any striving for psychological effect be definitely labeled as such. From the usual tone of press reports the general public is led to believe that the central station industry is most profligate in the use of coal, whereas just the opposite is true. There is nothing in the entire engineering history of the industry which, even in the present emergency, warrants anything but praise.

Daylight Saving

IN VIEW of the general efforts at economy the present session of Congress is likely to see another move toward the passage of a daylight-saving bill, which, in view of the agitation last year and the general results attained abroad, is quite likely to be made law. As we have intimated in discussing the matter previously, the actual decrease in the use of electric light resulting from daylight saving is not likely to be large; indeed, it is more than probable that it will be quite wiped out by increase in night work and the collateral uses of electricity. To sum up the discussion during 1917, most bodies which considered the matter at all were inclined to favor it. The only really adverse comment came from somewhat academic sources, and the objections raised were not such as have proved of material importance on the other side of the Atlantic.

With these companies, as with other industries, the situation is one which demands, not business as usual, but an adaptation of business to meet changed conditions. No man has a right in the face of the great war to expect to go on his way undisturbed by the tremendous struggle. He has a right to expect a chance to make himself profitably useful, whatever his original business, but his activities must change with the requirements of the situation. Similarly, supply companies must not anticipate their wonted distribution of business, although there is every reason to believe that there will be plenty of it in the aggregate. The soundest general policy to pursue would seem to be the intensive one of seeking out and taking over all the load which has been overlooked in the diversified efforts of the past. The amount of this, both in lighting and power, is large, and a very considerable increase can be and will be made in load taken squarely over on to the existing networks without considerable extensions, thereby increasing the load density and making better use of the costly distribution systems.

Particular attention ought to be directed toward those classes of load which actually mean increased efficiency of industry or obvious saving of fuel. As everybody knows, the balance of economy between central station supply and the isolated plant turns chiefly on the cost of fuel. The former has a great advantage in its general efficiency of utilization, and when coal supply is costly or difficult it is time for the owners of isolated plants to revise their balance sheets and see whether their expenditure has not become rather a foolish one. There is already considerable activity in taking over these isolated plants, and there is going to be far more in the future, since, however vigorous the efforts made by the Fuel Administration may be, it is a sure thing that coal prices are up to stay at least for the period of the war. Here is the place where the central station may reasonably expect to win out, despite the minor losses which may come from various small economies, among which is daylight saving.

Heaven for Housebreakers

FAR be it from us to doubt the wisdom of the Olympians, but if we were of burglarious disposition the recent call for two "lightless" nights per week would rouse in us a sentiment of profoundest gratitude. It used to be said that an electric light was as good as a policeman, and with what joy should we hail the suppression of any or all of these inconveniences to the profession of Raffles! We should judge it particularly thoughtful, too, to specify the lightless nights to be expected and to impress on the public the necessity of universally observing the same two evenings of darkness. Frankly, we have never been quite able to see why all men should abstain from pork on the same day of the week or fill up on fish on two other specified days. Indeed, the distribution of provender would be rather simplified by distribution of demand. But in this matter of the lightless nights universal agreement on the dates is really, from the standpoint of public safety,

a rather serious matter if any substantial attention is to be paid to this particular economy. We do not wish to register any kick in behalf of the electric light companies against a request to diminish the market for their product. They have shown no lack of patriotism and can be depended upon to stand by loyally, bearing their share of the public burden even though they cannot recoup themselves, as some others do, by raising prices at will. But, with all seriousness, effecting economy in fuel by the reduction of lighting may turn out to be a rather bad business.

Of course, we are not yet in the situation of London or Paris and have no need for protective darkening. The question here relates to the probable effect of systematic decrease of lighting on accidents and on crime. It certainly will not take any large experience to show positive results in these particulars, and we hope that the information thus gained will lead to general rather than specific recommendations for economizing light. This is only one of the many ways in which the individual can reduce expenditures to meet the war conditions which confront us, and it is to be judged strictly on its merits. As a measure for fuel saving we do not anticipate any startling degree of success for the new regulations. A few weeks' investigation of the load curve will tell the story. Certainly there are many more efficient ways of reducing waste of fuel much less open to serious objection. The 20 per cent or so of perfectly good fuel to be found in the ordinary ash can suggests immediate possibility of results, and the amount of coal wasted in heating practically unused rooms is another item that looms large in the total of domestic fuel expenditure.

Hope for Water-Power Conservation

WITH Congress likely to be in continuous session for many months, the coal supply short, and industries calling loudly for motive power, there must be a reasonable chance that the national legislature will at last permit the utilization of water powers on the public domain under terms that will be economically possible. Even Gifford Pinchot seems in some measure to have seen the light. In a recent letter to the press he lays down as a fundamental principle that "the thing to do with water power is to develop it. Whatever retards or restricts the development of public water powers on terms fair to the public is against public policy and hostile to the general welfare." One would suppose that this declaration might impose the duty of silence upon Mr. Pinchot, but instead he goes on to lay down half a dozen more propositions which together pretty effectively nullify his paving contract of good intentions. Briefly they are as follows: Hydraulic privileges belong to the people and should be retained as such in public hands. Where development by the public is not desired the rights should be leased for periods never exceeding fifty years, at which time the whole property would, of course, revert from the lessee to the lessor. Rates in service should be regulated by federal authority "when state or local authorities fail to do so." Prompt development should be demanded since, according to Mr. Pinchot's view, "millions of water horsepower are held out of use to further the monopoly of private corporations." Finally, those who make money out of rights granted by the people should share their profits with the public, which has a right to complete information about every such business.

Now, this pronunciamento is a curious complex of honest intentions and the brand of socialism affected by Trotzky. Mr. Pinchot explains that the people of the United States own about 50,000,000 undeveloped water horsepower, pretty nearly enough to meet our complete industrial requirements. What he does not state is that a very large amount of this power is at the present time so impossible to market that its usefulness must be deferred pending the growth of population and industry. Much there is, however, that could be developed and would be developed if the Bolsheviki element among so-called publicists in and out of Congress would permit it. Where water powers exist on the public domain in regions which are within the scope of prompt commercial development all are agreed that the work should be begun at once and pushed to the swiftest possible conclusion, in order to relieve the difficulties of fuel supply and to furnish power for the industries necessary to all. It will be readily granted by everybody, too, that public property should not be given away to private interests or transferred to their custody without reasonable payment therefor. So far as the consumer is concerned, it is a matter of indifference whether he pays the government or somebody else for his power, provided that it is obtained at a reasonable price for the service rendered. It is emphatically not true that it is necessary for the hydraulic privileges to remain in public hands, provided that the product obtained from them is under such control as will insure its development and distribution in such way and at such prices as shall be to the public benefit.

We do not think that "millions of horsepower" are held out of use to further monopoly. More effective monopoly could be insured by putting them into use and building up power-distribution enterprises on a gigantic scale, thereby increasing output and profits. The undeveloped water powers in private hands are undeveloped chiefly because there is no market for them within reasonable range at the present cost of construction, or because they are of a character requiring costs of development too high to be justified by the demand at present in sight. The natural course of events is that the privileges most easily developed should be first put into service, followed by the others as the certainty of market for their full utilization makes it profitable to bring them to use. As regards the powers on the public domain, those of them which are capable of development on an economically sound basis will be put to work as quickly as possible when Congress permits it on terms that will not be disastrous to those undertaking the enterprise. Right here is where Mr. Pinchot departs from the straight line of sound economics. Every public service corporation, from whatever source it derives its power, realizes its

public obligations and grants that it must be accountable for what it has received from general or local authorities by recognition of control by those authorities. What it asks is merely security against the virtual confiscation of the property which it has built up about such public privileges as have been granted to it.

Under existing statutes the right of public control of rates exists practically everywhere to the extent of regulation of prices to the consumer, and every corporation is compelled to make returns of its business in as complete a form as may be from time to time prescribed by statute. Under these rights the people of any state have power to protect themselves amply against the possible danger of extortion, and in virtue of price regulation they can and do compel public utilities to share profits with them by this means. The main issue in the premises seems to be the terms on which development of public powers should be permitted and the nature of the regulation which should be applied to them. We do not believe that the government itself will undertake the development of water powers on its own responsibility. Public ownership on a much lesser scale than this would imply has often been tried and generally found wanting. If the work is to be undertaken, on the other hand, by private capital, this cannot be secured, particularly under present conditions, unless it is reasonably assured that the investment will be a sound one and that it will be for a time long enough, and on terms reasonable enough, to give security to the investor not only for the capital put into the actual hydraulic development, but for the much greater amount necessary to secure adequate service to the consumer.

Electric Power in Rolling Mills

THOSE of our readers who are in close touch with the steel industry know to what extent electricity has been used for driving rolling mills; but very few outside the inner circle of the industry realize to what an extent the work has now been carried. Considerably more than 200 electrically driven rolling-mill plants are in operation, using, moreover, very large amounts of power even by the 1913 figures available. Since that time the business has increased considerably. The average kilowatt-hours generated per plant were little short of 10,000,000 annually, double the average output of the electric railway companies operating in the United States. In the largest plant then in operation the annual output rose to 330,000,000 kw.-hr., an amount which is comparable with the output of the largest class of central stations. Broadly, the advantages of electric power in rolling mills are similar to those found in other industrial works. The simplicity of the drive, the regularity of the speed which can be attained, the flexibility of the whole equipment, appeal as strongly to the engineer of a rolling-mill plant as to others. Besides these advantages, there is in many mills a considerable economy of power due to working the motors in reversal, which has a very perceptible effect on the power cost of operation.

As most engineers know, the general problem of electric drive in rolling mills is now purely an economic one, the fundamental question being whether such a drive is or is not cheaper than a steam-engine drive, and, granted that it is, whether it is cheaper to generate or to purchase power. Large electrical supply companies are able to deliver energy on the scale demanded by rolling mills at a figure which permits competing with power locally generated. The great public supply plant can work on so big a basis and derive so much benefit from the diversity factor that it is in a particularly good position to sell power cheaply in large blocks. The average rate offered by twenty central stations furnishing power to steel works is, as stated by a recent report on the subject, between 8 mills and 9 mills per kilowatt-hour. The methods of charging adopted are usually based on certain requirements for maximum demand plus a flat rate. Only in rare instances is the latter system of charging used alone. As is well known to our readers, the arrangements adopted for equalizing the enormously irregular loads in rolling mills are highly ingenious and on the whole very successful. We have from time to time published articles giving details of this work. For the present purposes it is sufficient to point out that the difficult problems presented have been very successfully solved, so that there is no sound reason for central stations in general being timorous about taking on rolling-mill load, assuming that its quantity is not so great as quite to swamp the station capacity. Generally, special provisions in the feeding system are necessary, and some extra care must be taken in the matter of regulation. But, by and large, the rolling mill offers to the large producer of electricity an excellent market for his product, and in turn the rolling mill is able to utilize it with a high degree of efficiency.

The Coming Issues

AS IS customary, the ELECTRICAL WORLD will devote the first issue of the new year to a review of the performance of the industry during the past year. Especial attention, however, will be given in the coming issue to the part that has been played by the electrical interests in helping the country successfully to wage the war. To few other industries has such an opportunity been given to serve the nation. No other industry has responded more promptly than the electrical industry in man power, resources and facilities. As a conserver of fuel and a supplier of energy for the manufacture of munitions of war and ships to transport them, as a producer of equipment that alone makes possible increased output of supplies and the spreading of intelligence quickly on the field, as the university from which the best of trained engineers enter the nation's service, the electrical industry stands apart as a war aid to the government. How this has been accomplished and how the industry has continued to maintain in almost full measure its great service to the public will be the theme running through the Jan. 5 number.

Factors Affecting Selection of Insulators

The Advantages and the Disadvantages of Ground Wire—Consideration of the Effects Exerted by Operating Surges and by Parallel-Circuit Operation—Local Conditions Always an Important Factor in This Problem

BY A. O. AUSTIN
Chief Engineer Ohio Insulator Company

IN CONSIDERING the investment needed for insulators "it is advisable to remember," said the author in the Nov. 10 issue of the ELECTRICAL WORLD, writing under the same heading, "that the relative cost of the insulator as compared to the remainder of the system is often under 3 or 4 per cent, and that there are only a few systems which could not afford to use more insulation simply as a matter of good business investment in safeguarding their plants." He then pointed out that the liability of interruption to service is dependent on the size of the system, that steel structures impose greater strains on insulators than wood poles, and that competition and the nature of the load are important considerations in determining the margin of safety to allow in insulators.

In this article he goes on to point out the advantages and disadvantages of ground wires, the effects of switching surges on insulators, the relative merits of independent and parallel circuit operation and the effect of local conditions.

ADVANTAGES AND DISADVANTAGES OF GROUND WIRES

Heretofore ground wires have been regarded from too narrow a point of view, their advantages being often doubtful, while the troubles that they cause sometimes offset any possible theoretical advantage. When used on a steel structure the ground wire will not greatly increase the danger of shorts caused by birds and may protect the insulator slightly. However, if the investment represented thereby is applied to increasing insulation, the benefits will be still more marked.

The use of a ground wire on a wood-pole line will protect the poles from being shattered, but the strain on the insulators will be increased and there will be more short-circuits from birds, insulator flashovers and punctures. Where a good, effective cross-arm is used the disadvantages of a ground wire will not be so noticeable, but when a wood-pole line is equipped with metal cross-arms tied into the ground wire the system has all the disadvantages of a steel-tower line in so far as the danger of flashovers and short-circuits developing is concerned, and will have the further disadvantage of requiring more insulators per mile. A bird standing on the cross-arm may cause a short-circuit, even with the largest pin insulator, unless it is mounted on an abnormally long pin. This trouble, although negligible on a short line, may seriously affect the service on a long line.

Since the flashover strength of an insulator must be more than 300 kv. practically to eliminate spillovers from lightning, the largest pin insulators cannot be expected to prevent "kick-outs" from lightning when mounted on a grounded cross-arm.

The removal of the ground wire will clear up many cases of trouble, but if needed to prevent poles from being shattered it should be so installed that its disadvantages will not outweigh its advantages. A small wire run down each pole will protect the latter from being shattered and ground resistance will prevent many "spills" from developing into "shorts." If the wire is insulated from the poles, it will be still more effective. On one large system using part metal and part wood construction serious trouble developed from short-circuits by birds or from flashovers from lightning, although in no case did an insulator fail. Insulating the ground wire in such a way that the metal arms were not grounded removed the trouble entirely.

It must be remembered that guyed structures will have a greater electrical hazard than ungrounded wooden poles, and very much larger insulators will be required to furnish the same reliability that smaller ones will give on wooden structures. Therefore the

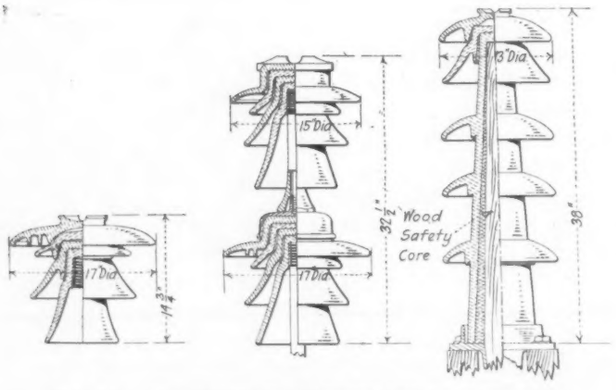

FIG. 1—FOUR-PETTICOAT, TANDEM AND POST TYPE PIN INSULATORS

The trouble from insulators flashing over is so serious that the tendency is to raise the insulation where lightning will not flash the insulators. This requires the equivalent of a seven-section insulator or a tandem insulator like that shown.

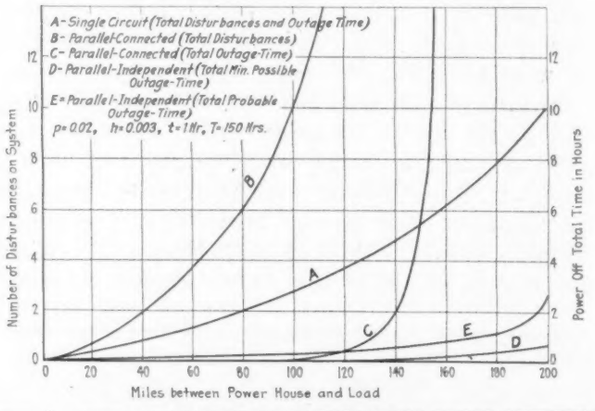

FIG. 2—POSSIBLE NUMBER OF DISTURBANCES UNDER DIFFERENT OPERATING CONDITIONS

Where W equals the number of disturbances the probability that a circuit will be out is $p = Wt/T$; the probability of two circuits p_1 and p_2 being out will be P_1P_2, and the probable time that power will be off the line will be P_1P_2T.

use of guys, unless thoroughly insulated, is of doubtful value at crossings and other points where it is desired to make the construction very safe.

The hazard caused by strain insulators is many times that obtained with suspension insulators, hence the mechanical advantages will have to be very marked to warrant their use. The depreciation rate for strain

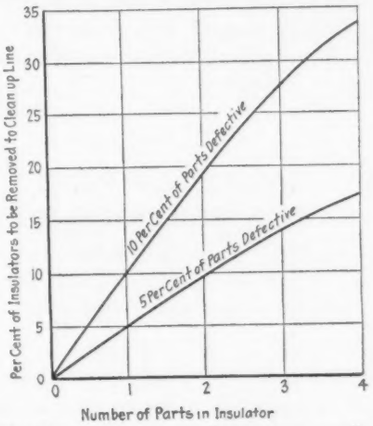
Per Cent of Insulators to be Removed to Clean up Line
10 Per Cent of Parts Defective
5 Per Cent of Parts Defective
Number of Parts in Insulator

FIG. 3—PROBABLE AMOUNT OF "WEEDING OUT" NECESSARY UNDER DIFFERENT CONDITIONS

insulators is more than double that of suspension insulators, so that in the larger insulators the hazard increases from thirty to sixty times that for suspension insulators, owing to matching of defects.

Protection can be secured by the use of weather shields or short disk-spacing, so that the one part affords protection for another by the removal of defective material before it can cause trouble and by the rotation of the insulators after a period of service so as to expose new parts and relieve the stressed ones.

EFFECT OF SWITCHING SURGES ON INSULATORS

When the line insulation gets in very bad shape owing to the matching up of a number of faulty members, it sometimes happens that when service is once interrupted it is practically impossible to restore and maintain it until the voltage is built up slowly. The natural conclusion is that the switching surges must be abnormal. Investigation, however, shows that serious trouble often exists with a comparatively slight rise in voltage during switching, due to high-frequency oscillations. While these may not be destructive to porcelain as ordinarily used in insulators, they do tend to locate air pockets or internal defects with a partial vacuum. It is this latter characteristic which makes switching surges troublesome.

The current flowing in an air pocket increases with the frequency, since the pocket is really a poor conductor in series with the rest of the dielectric which forms a condenser. The increase in current causes a large I^2R loss, which in turn heats the air and dielectric, causing the resistance of the insulator to drop to a point where it will fail. This phenomenon is particularly dangerous in multi-part insulators which have depreciated sections, because if one part breaks down a larger stress is thrown on the remaining sections.

From the preceding remarks and the accompanying data it follows that (1) the switching surges cause large operating hazards where there is much insulator depreciation; (2) a line which does not have switching surges will give good service with considerably less insulation than a line having switching surges; (3) switches which insert resistance or reactance prior to opening are more valuable than generally supposed and should be further developed; (4) if switching is to be general practice, larger insulators should be used or the poor material should be removed from the line more frequently; (5) when difficulty is experienced in restoring or maintaining service after interruption, time should be taken to build up the voltage gradually, splitting up the system if possible while doing so; (6) low charging current in insulators lessens the shunting of defective parts, hence insulators with small electrostatic capacity or those mounted on wooden structures have, for the same depreciation, a lower secondary hazard than those of larger electrostatic capacity or when mounted on steel structures; (7) arresters or other apparatus which induce high-frequency disturbances should have resistances in series with them for minimizing disturbance; (8) hot weather, unusual bird trouble, high winds or electrical storms may greatly increase the primary hazard, so that it is advisable to split up the system, even if only for a short time, going back to a larger connected mileage as soon as the primary hazard is reduced to normal.

Lightning, although producing a high local hazard, has a relatively small effect on the total system hazard, so that switch surges are more to be feared. For instance, a line of seven-section insulators operating so that $g = 1$ constitutes a hazard will have 0.01 dangerous strings per thousand. If a switching surge produces a hazard when $g = 3$, it may be seen that there are 0.95 dangerous strings per thousand. The hazard has been increased $0.95 \div 0.01 = 95$ times. If the line was 300 miles (482.8 km.) long and the secondary hazard was $h = 0.003$ for the switching disturbance,

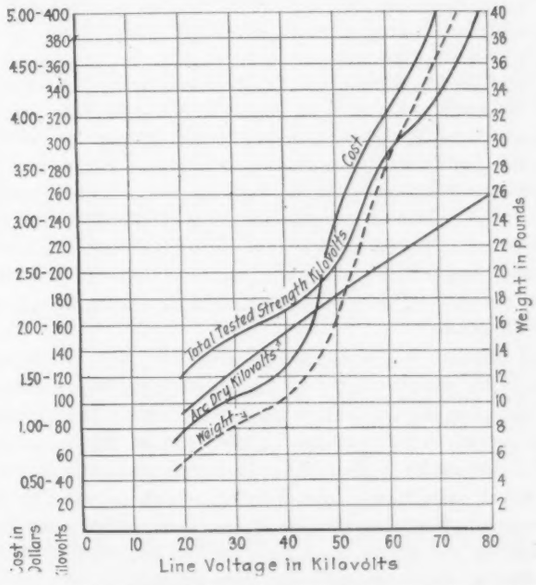

FIG. 4—TESTED STRENGTH OF INSULATORS HAS KEPT PACE WITH PRICE

there would be sixty failures in a given time. In the case taken, however, the switching disturbance would cause 0.95 cases of secondary trouble compared to 0.01 at normal voltage. If the switching surge was eliminated, then, by building up or other means, the secondary hazard h would be $0.01 \div 0.95 \times 0.003 = 0.0000316$.

By referring to Fig. 1 in the author's article of Nov. 10 it will be seen that a line having a secondary hazard $h = 0.0000316$ will have a negligible secondary hazard, hence a total of six interruptions only. It is further evident that a very long mileage could be operated where $h = 0.0000316$ and the primary hazard p is low, whereas the switching surge would probably reduce the possible mileage to under 200.

INDEPENDENT VS. PARALLEL CIRCUIT OPERATION

The use of automatic relays may maintain service practically all the time where there are two lines serving a load, although there may be a number of interruptions on either circuit. However, if the secondary hazard h is high, much better operation may be obtained by operating the lines independently.

From Fig. 2 in this article it will be noted that up to 150 miles (241.4 km.) the parallel circuit has far more disturbances (B) than the single line (A), but the time that power will be off (C) will be less. After this mileage is exceeded the single circuit not only has fewer disturbances but less time outage. Hence the single circuit would give far better service than the parallel circuits even when tied together and operated with automatic relays. The curves constitute another argument for splitting up the system, so as to have A in place of B disturbances and D or E for outage time in place of C.

EFFECT OF LOCAL CONDITIONS

The practice of paying little or no attention except to very highest altitude is undoubtedly good practice as far as insulator performance is concerned, since the clear air, lower temperature, lower stresses and greater dielectric factor of safety all go to increase the reliability or permissible operating voltage for any insulator and will usually more than offset the reduction in flashover.

Conditions around large cities are becoming more severe each year, and insulators which would formerly have given good service cause no end of trouble by burning pins or from increased surface leakage. This condition calls for refinements in the insulator rather than size. For these conditions an insulator should be made up of parts having low surface stress. Since the energy expended in the pin increases as the square of the current, the small electrostatic capacity is well worth while.

If there are some points on the system difficult to get at or which offer particular hazards, it is advisable to increase the insulation at these points either through the use of more sections in the case of the suspension insulator or by a change in the type of construction or a larger insulator. The better insulators usually have fewer number of parts, as it is believed that they form a better compromise. Few well-made parts can be made for less cost, and the depreciation is likely to be very much less. The more cement surface an insulator has the more uneven will be the temperature distribution, and this at best is likely to set up serious stresses unless relief is provided. The mechanical stresses also go up almost directly with the diameter of the cement areas.

Another important factor in a pin-type insulator is that where a large number of parts are used the rate of depreciation must be very small, otherwise the number of insulators which have to be scrapped to weed out a comparatively small percentage of defective parts is likely to be prohibitive (see Fig. 3).

It may be noted from Fig. 4 that, although the cost of a pin-type insulator goes up very rapidly as the size increases, the total tested strength of the parts has increased almost at the same rate as the cost. This would not have been possible had it not been for the successful manufacture of the more efficient designs, the benefits to be derived from the proper use of which are by no means exhausted.

THE UTILIZATION OF PIPE FOR OUTDOOR BUS WORK

Charts Giving Deflections of Copper, Brass and Iron Pipe With and Without Ice Load Designed for High-Tension Apparatus

BY M. M. SAMUELS

Copper, brass and iron pipe is now being used extensively in high-tension parts of outdoor substations for buses and connections, the great advantage of being able to support it on rigid insulators instead of by strain insulators being generally recognized.

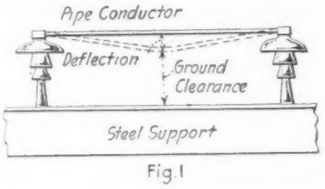

Fig. 1

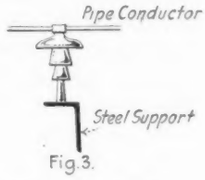

Fig. 3.

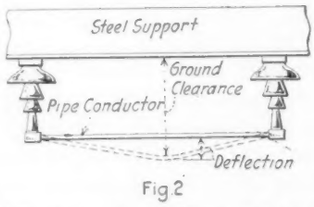

Fig. 2

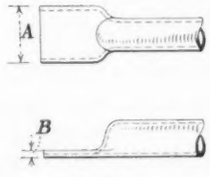

Fig. 4

FIGS. 1 TO 4—GROUND CLEARANCE WITH BUSBARS STRUNG ABOVE, BELOW AND ACROSS STEEL SUPPORT—FORM OF TERMINAL

No strict rules can be made as to how far apart pipe-bus supports should be. The exact spacing of insulators must be determined in each individual case. For instance, where a conductor runs parallel to a steel member, as in Fig. 1, with the steel member underneath the conductor, a large sag will considerably decrease the ground clearance. Therefore insulators must

DIMENSIONS OF FLATTENED COPPER OR BRASS PIPE FOR TERMINAL

	Size of Pipe in Inches										
	¼	½	⅜	½	¾	1	1¼	1½	2	2½	3
Standard iron-pipe size:											
A	0.57	0.76	0.96	1.20	1.52	1.86	2.44	2.82	3.56	4.32	5.28
B	0.12	0.17	0.18	0.22	0.23	0.24	0.29	0.30	0.31	0.38	0.44
Extra heavy iron-pipe size:											
A	0.54	0.72	0.91	1.15	1.48	1.85	2.39	2.76	3.49	4.20	5.16
B	0.20	0.25	0.25	0.30	0.31	0.35	0.39	0.41	0.44	0.56	0.61

be spaced so that even with a maximum sag under ice conditions there will still be enough clearance between the conductor and the steel. But even for an individual case like this no rule can be made as to the minimum spacing of insulators, since the ground clearance at maximum sag will depend upon the insulator's height.

When the conductor is suspended underneath the insulator with the steel above the conductor, as in Fig. 2, or when the conductor runs at right angles to the insulator, as in Fig. 3, a greater sag and consequently a greater distance between supports is permissible. In this connection it may be mentioned that the majority of standard insulator pins on the market at present are too short to allow for the required ground clearance when used as in Fig. 1, since most standard pins are designed for cross-arm use as in Fig. 3. Caution should be used therefore when deciding upon the type of pin for a high-tension bus support.

The accompanying curves give the deflection of the various kinds of pipe for different spacings of insulators, both without ice load and with ice load. They may be used readily for determining the required spacing of insulators after a certain kind of pipe has been decided upon or to determine the size of pipe to be used when the distance between supports is fixed through other determinations. The deflections given are for two end supports and are therefore maximum. For a continuous pipe with more than two supports the deflections will be considerably less than those given.

The simplest method of connecting a pipe connector to a terminal is to flatten the pipe, drill a hole through it, and use the pipe conductor itself as a terminal lug.

Electrical Determination of Ore Beds

Dr. Reginald A. Fessenden of Brookline, Mass., describes in patent No. 1,240,328 a method by which he has actually been able to detect and determine the location of a body of mineral invisible to the eye at a distance of 2.5 miles (4.0 km.). In general the method consists in drilling four holes in the earth a given distance apart—for example, 5 miles (8.0 km.)—filling these holes with water so that proper receiving and sending apparatus can be let down, and noting the differences recorded on the several receiving instruments. The apparatus employed would in the above case be three photographic recording oscillographs of the Einthoven type coupled to microphone receivers and a single strong underwater sound-wave oscillator of the kind developed by Dr. Fessenden for submarine signaling work. Given the distance between two points in a mine and having determined the time taken by a sound wave to travel between the two points, it is possible to draw conclusions in regard to the probable nature of the rock between the two points, or if an echo be observed or a refraction of the sound, it is possible to estimate the distance of the reflecting or refracting vein.

Since the oscillograph photographic strip moves with a regular and known velocity, the distance on the strips between the records produced through the transformers when the key is pressed down and the records made by the sounds received, whether direct, or by reflection or refraction, or by the echo, indicates the distance between the drill holes and the ore bodies.

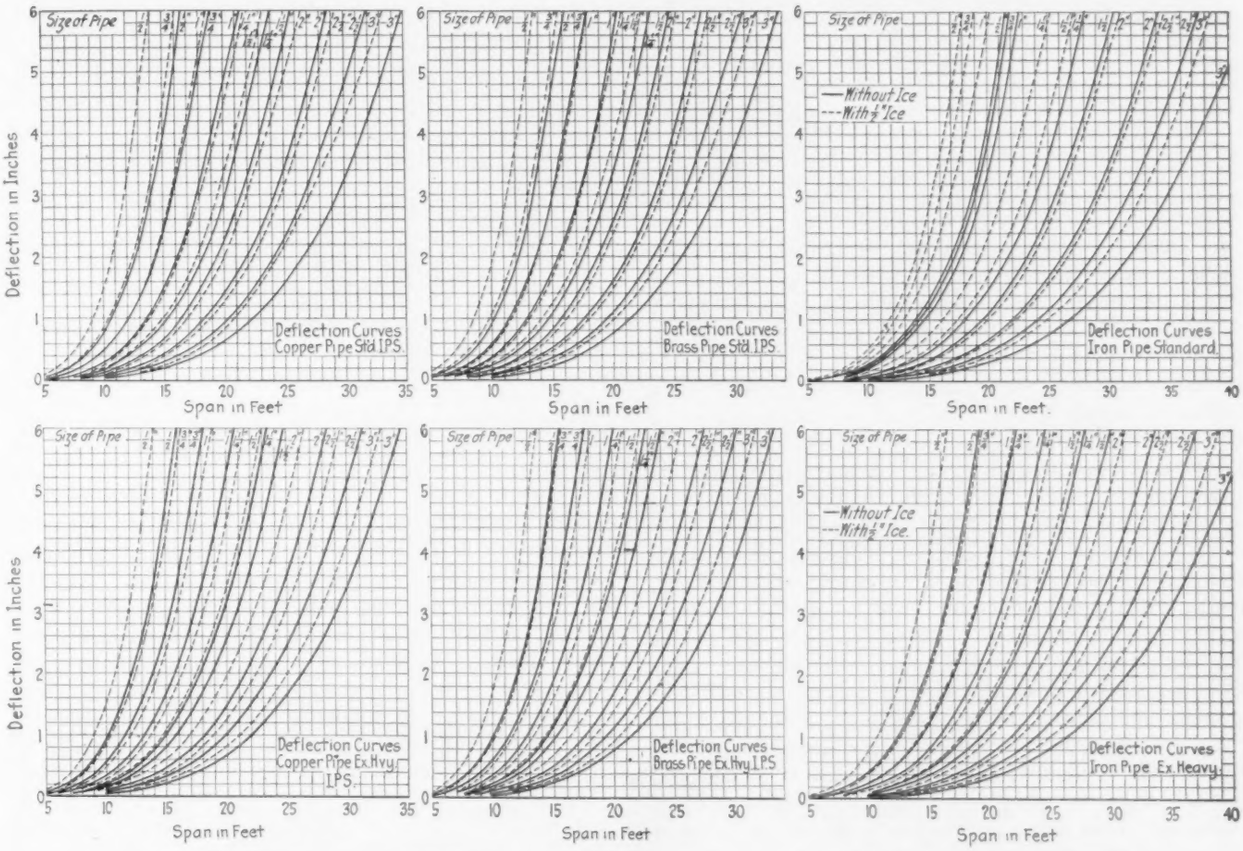
Size of Pipe
Deflection in Inches
Span in Feet
Deflection Curves Copper Pipe Std I.P.S.
Deflection Curves Brass Pipe Std I.P.S.
Without Ice
With ½" Ice
Deflection Curves Iron Pipe Standard
Deflection Curves Copper Pipe Ex. Hvy. I.P.S.
Deflection Curves Brass Pipe Ex. Hvy. I.P.S.
Without Ice
With ½" Ice.
Deflection Curves Iron Pipe Ex. Heavy.

FIG. 5—DEFLECTION OF COPPER, BRASS AND IRON PIPE USED AS BUSBARS WITH AND WITHOUT ICE LOAD

Factors Affecting Application of Motors to Lathes

Necessity of Knowing Work for Which Lathe Will Be Used in Order to Arrive at Correct Conclusions in Providing Motor Drive—Methods of Calculating Power Required—Speed Requirements

BY C. E. CLEWELL

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SYNOPSIS.—In this, the ninth installment of a series of articles on industrial motor and control applications, the lathe is taken as one of the typical classes of machine tools with which motors are widely used, and some of the practical points related to the application of the motor to such machines are discussed in detail. A typical piece of work calling for several operations throughout the duty cycle is used as the basis for showing how the root-mean-square horsepower may be calculated for such a cycle when the graphic record of current input to the test motor is available. Reference is also made to the approximate calculation of horsepower on the basis of the cubic inches of metal removed per minute. The requirements of speed are treated at some length, and notes on the control problem are included along with simplified wiring diagrams applicable to a given type of machine-tool controller.

NEARLY every application of motors has its own peculiar characteristic, so that the analysis of the motor requirements may be simplified by the selection of some one industry or a given type of machine tool and limiting the discussion thereto. In this article it is proposed to take the lathe as an example of one class of industrial machinery and to point out some of the elements connected with the selection of a motor suitable for driving such a machine.

The average lathe, in contrast to the planer, for example, is essentially a non-reversing piece of apparatus. Even where reversal[1] becomes necessary occasionally the motor may readily be reversed by the ordinary drum machine-tool controller, and no special reversing mechanism is ordinarily required as with the planer. Furthermore, the need for an adjustable-speed rather than a constant-speed motor will depend somewhat on whether the lathe is used for one given standard operation, and consequently requires only one or at most a few speeds of small ranges, or whether it is used for special or repair work, including a wide range of diameters, and thus has a correspondingly wider range in the speed requirements.

However, even where a lathe is purchased primarily for a standard operation, natural changes in manufacture are likely to result in its use for turning sizes of

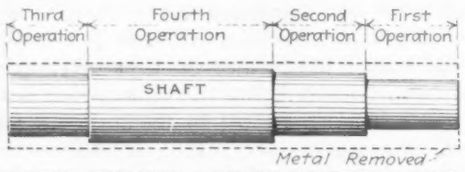


FIG. 1—SECTION THROUGH A SHAFT ON WHICH FOUR OPERATIONS ARE TO BE PERFORMED IN A LATHE (SEE FIG. 2)

work with diameters which differ from that in the first instance, so that the question of the possible ranges in diameters of the work and the necessary changes in the r.p.m. of the work often become important.

[1]It becomes necessary, of course, to reverse the spindle now and then when reversing the progression of the cutting tool along a shaft, but the rotation of the work for any given operation is usually continuous and is hence in one given direction.

Fundamentally, the lathe is used for the removal of metal, from a shaft, for example, where the cutting tool makes a cut of a certain depth and each succeeding revolution of the shaft results in a given progression of the tool along the shaft known as the feed. The depth and width of the cut, together with the peripheral speed of the shaft, determine the power requirements

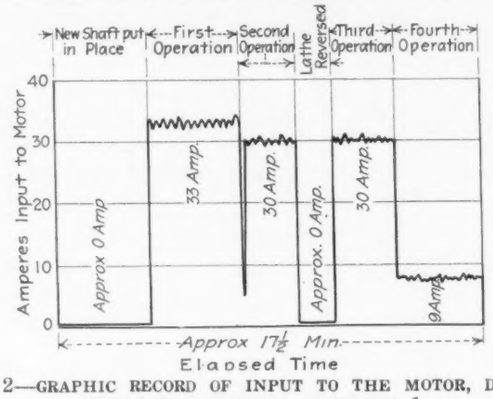


FIG. 2—GRAPHIC RECORD OF INPUT TO THE MOTOR, DRIVING THE LATHE REFERRED TO IN FIG. 1

for a given kind of metal. To this must be added the power losses in the lathe itself, these two elements constituting the power which must be supplied by the motor to the lathe. In some cases the power required by the removal of metal is so small in comparison with the mechanical losses in the lathe that the driving motor may be selected on a basis of the losses only. However, where the power required by the cut is large in comparison with the losses, the latter may be neglected and the power requirement based entirely on empirical formulas in terms of the cubic inches of a given kind of metal removed per minute.

Where the determination of the power requirement is based on the measured input to a test motor used for driving the lathe under operating conditions, obviously both the mechanical losses and the power for removing the metal are taken into account, and hence this scheme for testing out the required horsepower is to be preferred.

The present problem may therefore be divided into two parts, one of which relates to the motor and the other to the methods of control for obtaining the required operating characteristics. In discussing the motor attention will be directed, first, to the question of its horsepower rating; second, to its speed range, and, third, to the practical item of how the motor may be connected to the machine tool.

HORSEPOWER REQUIREMENTS

Three possible schemes are presented for deciding on the rating of the motor to employ for driving a lathe: (a) Tables of average ratings for a lathe of the given size as issued by the motor manufacturers may be con-

sulted. (b) A calculation may be made of the cubic inches of metal removed per minute, which should take into account the maximum as well as the average. Constants are available for various metals, which if multiplied by the amount of metal removed by the cutting tool per minute indicate the horsepower required to remove the metal. As pointed out above, this scheme may not take into account the mechanical losses in the

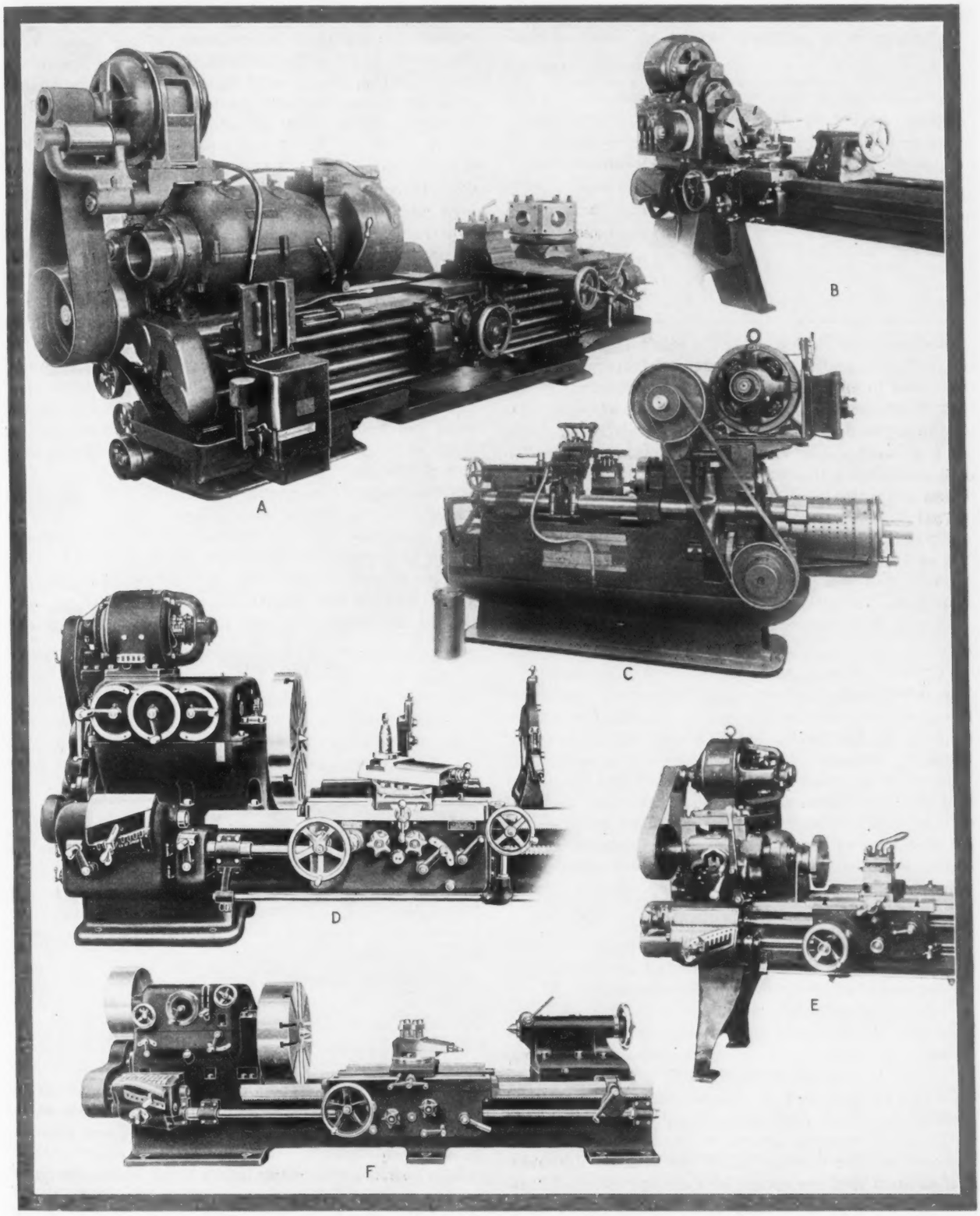


FIG. 3—DIFFERENT METHODS OF CONTROLLING LATHE MOTORS

A—Motor mounted on lathe but belted thereto. B—Snap-switch control for motor driving lathe through gears with sliding idler. C—Motor-driven lathe in which speed adjustments are obtained by change gears (quick speed changes are not necessary as machine is used for long runs). D—High-duty lathe which can use either constant-speed or adjustable-speed motor by connecting through twelve-speed geared head (apron control is used). E—Motor arm arranged for driving geared head. F—Geared-head lathe which can be driven at fifteen different speeds by constant-speed motor.

lathe but merely give the net power required at the point where the cut is being taken. (c) A test motor may be attached to the lathe temporarily and a graphic record of the amperes input taken throughout one or more duty cycles. Such a chart may be used as the basis for calculating the r.m.s. horsepower as well as the maximum or peak requirement, as described below.

TABLE I—CALCULATION OF THE R. M. S. CURRENT INPUT TO THE MOTOR OF A MOTOR-DRIVEN LATHE

Amp.	Time, Seconds	Calculated R. M. S. (Amp.)^2×Time
33	180	1089×180 = 196,020
30	140	900×140 = 126,000
0	112	0×112 = 0
30	171	900×171 = 153,900
9	260	81×260 = 21,060
0	190	0×190 = 0
		Total.....496,980

Suppose, for example, that a shaft is to be turned as in Fig. 1, and that the sequence of operations is as indicated in the diagram. Suppose, furthermore, that Fig. 2 represents a graphic record of the amperes input to the motor during the operations involved in turning such a shaft. The complete duty cycle includes two rest periods for the motor, (1) while the new shaft is being put into place, and (2) when the lathe is reversed between the second and third operations.

Table I is a summary of the duty cycle shown in Fig. 2. Here the average current for each operation is squared and multiplied by the time (seconds) of the operation, the total of such products being 496,980. The total time of the one cycle is 1053 seconds, and hence:

$$\text{r.m.s. current} = \sqrt{496{,}980 \div 1053} = 21.7 \text{ amp.}$$

The determination of the r.m.s. horsepower rating of the motor depends on the supply voltage and on the efficiency of the motor. At 220 volts and 86 per cent efficiency the r.m.s. horsepower rating of the motor required is 5.5, while the peak requirements during the first operation amount to 8.3 hp. These are sufficient data on which to base the selection of the motor rating for the class of work involved. For reasons already stated it constitutes a more accurate method than either of the other two methods mentioned.

Speed Requirements

The peripheral or cutting speed of a shaft in a lathe with a diameter d inches and revolving at n revolutions per minute is given by the simple relation:

$$\text{Cutting speed (ft. per min.)} = \pi\, d\, n \div 12.$$

This may be expressed conveniently in terms of n as follows:

$$n = (\text{cutting speed} \times 12) \div \pi\, d.$$

From this equation it follows that the rotational speed of the shaft (sometimes called the spindle speed of the lathe) depends directly on the cutting speed and inversely on the diameter d of the shaft. Moreover, it is obvious that the speeds of a directly coupled individual motor depend directly on n. Hence in the analysis of the speed requirements of the motor it is convenient to study the effects upon n produced by changes in the cutting speed and in the diameters of the work to be turned in the given lathe.

The practice in cutting speeds was materially modified by the invention of high-speed-tool steel as a substitute for the older carbon-steel cutting tools. With its use it has been possible to increase the speeds for metal cutting from say 20 ft. to 40 ft. (6.1 m. to 12.2 m.) per minute for soft steel up to 80 ft. and 160 ft. (24.4 m. and 48.8 m.) per minute, and up to 50 ft. and 75 ft. (15.2 m. and 22.9 m.) per minute for cast iron. Cutting speeds for finishing run even higher. Depending, therefore, upon the kind of metal worked upon and partly upon the nature of the operation, that is whether a roughing or a finishing cut is being taken or some intermediate condition, the cutting speed has come to be looked upon as a fairly definite factor for given operations. In other words, there is a most economical cutting speed, beyond which mechanical limitations, such as undue shortening of the life of the tool or too rapid a deterioration of its cutting edge and excessive racking of the machine itself, come into play. On the other hand, to employ a cutting speed below the most economical value means a longer time for the duty cycle and consequently a higher production cost for the work.

Conversely, if owing to limitations in the speed ranges with the use of cone pulleys and belts the work in a lathe has has been performed at cutting speeds say 5 or 10 per cent below the economical value, the substitution of a motor with sufficient speed ranges and gradations so that practically any diameter of work can be accommodated with a motor speed which will result in the most economical cutting speed means in turn a material increase in production for the same labor cost or a reduced labor cost for a given amount of work performed.

TABLE II—RESULTS OF AN ANALYSIS OF LATHE SPEEDS UNDER POOR AND IMPROVED CONDITIONS

	16 In. ×48 In.		16 In. ×36 In.		16 In. ×36 In.	
	Poor	Improved	Poor	Improved	Poor	Improved
Maximum speed (r.p.m.), gear out	530	400	580	400	624	200
Minimum speed (r.p.m.), gear out	90	100	143	100	114	50
Back gear ratio	12	5	7.5	5	8.8	5
Maximum speed (r.p.m.), gear in	44	80	77	80	71	40
Minimum speed (r.p.m.), gear in	7.25	20	19	20	13	10
Per cent gap in speed	105	25	85	25	61	25
Minimum diameter of work	1 in.	1 in.	1 in.	1 in.	2 in.	2 in.
Maximum diameter of work	10 in.	10 in.	8 in.	8 in.	16 in.	16 in.
Maximum cutting speed at minimum diameter	139	100	152	100	326	100
Minimum cutting speed at maximum diameter	19	50	40	40	55	40
Cutting speeds not possible:						
On 1-in. diameter	12–23	21–26	25–40	21–26	20–35	11–13
On 2-in. diameter	25–50	42–52	40–75	42–52	40–70	21–26
On 3-in. diameter	35–70	62–78	60–110	62–78	60–100	33–39

It is possible with many lathes to accommodate quite a wide range of diameters, with the result that the same lathe may be used for any or possibly all of the diameters at one time or another. In Table II, for example, the first lathe can accommodate work ranging from 1 in. to 10 in. (2.54 cm. to 25.4 cm.). Suppose the maximum cutting speed desired is 100 ft. (30.5 m.)

[2] In the preparation of Figs. 1 and 2 and Tables I, II and III three articles by A. G. Popcke, *American Machinist*, Vol. 37, No. 3, have been consulted freely. The reader will find the extended analysis of motor drive for lathes in these articles an excellent treatment of the subject, primarily from the standpoint of factory management. The present article approaches the subject rather from the engineering viewpoint.

per minute, this immediately fixes the maximum r.p.m. of the lathe spindle which occurs when the smallest diameter (1 in.) of work is in place; namely, about 400 r.p.m. Assuming further that a four to one speed-range, adjustable-speed motor is used, the minimum sprindle speed without the aid of gear changes will be

current or alternating-current type for such work must be accompanied by mechanical speed-changing facilities if production is to be maintained at its most efficient standard. Even where the desired speed ranges are possible with mechanical means, it is apparent that many operators will prefer a lower cutting speed to

TAPLE III—PORTION OF A CHART PROPOSED FOR USE IN MACHINE SHOPS SHOWING THE RELATION BETWEEN FEEDS, CUTTING SPEEDS, DIAMETERS OF WORK AND SPINDLE SPEEDS ON LATHES

Feed (in. per rev.): Cast iron	....	0.18	0.14	0.11	0.09	0.08	0.07	0.06	0.055	0.043	0.036	....	....	....
Machinery steel	0.17	0.12	0.09	0.075	0.06	0.055	0.045	0.04	0.035	0.03	0.025	....	....	....
Tool steel	0.10	0.07	0.05	0.04	0.035	0.028	0.025	0.022	0.02	0.016	0.012	....	....	....
Brass	....	....	....	0.20	0.17	0.14	0.12	0.11	0.10	0.08	0.06	0.05	0.03	0.02
Cutting speed (ft. per min.)	20	30	40	50	60	70	80	90	100	125	150	200	250	300
Diameter (in.): ½	160	240	320	400	480	560	640	720	800	1000	1200	1600	2000	2400
1	80 **14**	120	160	200	240	280	320	360	400	500	600	800	1000	1200
2	40 **6**	60 **11**	80 **14**	100 **16**	120	140	160	180	200	250	300	400	500	600
3	30 **3**	45 **7**	60 **11**	75 **13**	90 **15**	105 **16**	120	135	150	188	225	300	375	450
4	20 **16-a**	30 **3**	40 **6**	50 **9**	60 **11**	70 **12**	80 **14**	90 **15**	100 **16**	125	150	200	250	300
5	16 **15-a**	24 **2**	32 **5**	40 **7**	48 **9**	56 **11**	64 **12**	72 **14**	80 **15**	100 **16**	120	160	200	240
6	13.3 **13-a**	20 **1**	27 **3**	33 **5**	40 **7**	47 **9**	54 **11**	60 **12**	67 **13**	84 **14**	100 **16**	134	167	200
7	11.4 **10-a**	17 **14-a**	23 **1**	28 **2**	34 **4**	40 **6**	46 **8**	51 **9**	57 **10**	71 **12**	85 **14**	114	142	171
8	10 **9-a**	15 **13-a**	20 **16-a**	25 **1**	30 **3**	35 **5**	40 **6**	45 **7**	50 **9**	63 **11**	75 **13**	100 **16**	125	150

As an example of how such a chart may be used, consider machinery steel. For a feed of 0.07 in. (0.178 cm.) per revolution a cutting speed of 60 ft. (18.3 m.) per minute is indicated, and hence for a shaft 5 in. (12.7 cm.) in diameter a spindle speed of 48 r.p.m. is required. This is accomplished by controller notch 9 in the equipment corresponding to this table. The bold-face figures indicate the position in which the controller should be (see Fig. 4). The sub-letter *a* accompanying some of the controller notch indications means that in such instances it is necessary for the back gear to be thrown in.

400/4 = 100 r.p.m., for a maximum spindle speed of 400 r.p.m. To find whether 100 r.p.m. is low enough to accommodate the maximum diameter of work, assume that the minimum cutting speed for the maximum diameter is 50 ft. (15.2 m.) per minute. Then the spindle speed of the lathe to give this minimum cutting speed with the maximum diameter of work (10 in.) must be about 20 r.p.m. This being the lower limit of spindle speed, it follows that with a minimum of 100 r.p.m. (above) through the range of motor speed adjustment, a five to one back gear must be employed. With the back gear in, the motor may now be speeded up from its lowest to its highest speed, that is, in the ratio of one to four, increasing the spindle speed from 20 to 80 r.p.m.

To summarize, the extremes in diameters and cutting speeds of the first lathe in Table II are met with a four to one adjustable-speed motor and a back gear having a ratio of five. For direct connection of the motor to the machine such a plan means a range in speeds from 100 to 400 with the back gear out and from 20 to 80 with the back gear in, thus leaving a gap from 80 to 100 r.p.m. throughout which it is impossible to obtain spindle speeds with this lay-out of equipment. Inasmuch as it may sometimes occur that important cutting speeds for certain diameters of work require such a range of spindle speeds, it is desirable to keep a gap of this kind down to limits of 15 to 25 per cent.

The analysis tabulated in Table II shows that the ranges in speed, even where quite wide, may be met successfully by the four to one adjustable-speed motor. The use of a constant-speed motor of either the direct-

shifting belts or gears. This leads naturally to the subject of control for adjustable-speed motors which are called upon to meet the requirements.

The foregoing discussion of the speed requirement points clearly to the importance of wide ranges in speed (for many lathes) and the necessity for carefully planned gradations in speed. The latter may readily be provided by the modern controller (Fig. 3), but not

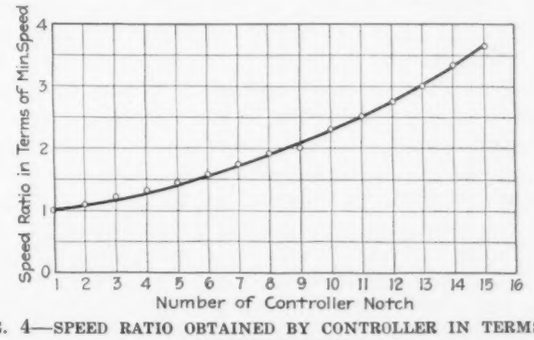


FIG. 4—SPEED RATIO OBTAINED BY CONTROLLER IN TERMS OF MINIMUM SPEED

This curve is based on geometric speed increments, each succeeding speed being about 10 per cent greater than the immediately preceding value. The futility of attempting such a gradation of speeds by cone pulleys, for example, is apparent.

so well perhaps with mechanical speed changes. Even if the mechanical speed-changing facilities give comparable increments, the controller still has the important advantage of convenience both in operation and location with respect to the machine-tool operator.

While the motors for small lathes may be operated by face-plate controllers, a more standard form is the combined drum and dial type, in which starting is ac-

complished by the drum part of the controller and speed adjustment by the dial part (Fig. 3).

While the application of motors to old belt-driven machine tools often makes it necessary to mount the motor as a separate unit, and possibly to supply the power through a counter shaft, the tendency in the manufacture of modern tools is to make the motor an integral part (see Fig. 3) of the machine. This method has many advantages.

FURNACE CHANGES BRING INCREASED BOILER ECONOMY

Furnace Interiors Designed to Reflect Heat Back to Green Coal to Hasten Ignition and Produce Increased Economy

An Iowa central station company operating several 300-hp. Heine water-tube boilers found it difficult to develop more than 70 per cent of the boiler rating with steam coal. The grate surface under each unit measured about 60 sq. ft. (5.4 sq. m.) and each boiler had about 3000 sq. ft. (276 sq. m.) of heating surface, making the ratio of grate area to heating surface one

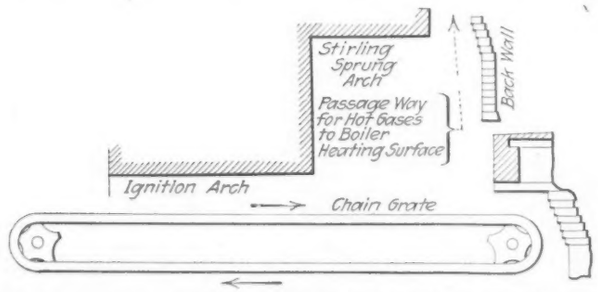


FIG. 1—FURNACE WITH SPRUNG ARCH ORIGINALLY INSTALLED UNDER 500-HP. WATER-TUBE BOILERS

to fifty. Over the grate there was a flat arch 6 ft. (1.8 m.) long. It was installed parallel to and about 14 in. (35.6 cm.) above the face of the grate. Later Stirling boilers each of 500-hp. rating were installed, with 138 sq. ft. (12.9 sq. m.) of grate area and 4920 sq. ft. (452.6 sq. m.) of heating surface. The new ratio was about one to thirty-six. For one furnace a flat arch 6 ft. (1.8 m.) long was installed parallel to and 15 in. (38.1 cm.) above the face of the grate. A Stirling sprung arch was also installed, as illustrated in Fig. 1. With this equipment it was found possible to develop about 120 per cent of the boiler rating, or 50 per cent more than with the old furnaces and boilers. The increase in rating was considerably greater than the increase in grate area, but one fault still remained. With the draft maintained at the pressure necessary for hard forcing the fire would die down at the front of the grate and allow the ignition arch to cool off. It would then be necessary to reduce the draft pressure as well as the rate of evaporation in order to heat the arch again.

After some experimentation the improvements indicated in Fig. 2 were made. The Stirling sprung arch was taken out and the flat ignition arch was inclined until the lower face of its rear end was 3.5 ft. (1.1 m.) above the grate, while its front end remained at the former level, 15 in. (38.1 cm.) above the grate. The bridge wall was also raised. These modifications were made in order to reflect heat from the hottest part of the furnace back against the green coal and thus hasten the beginning of combustion.

Results have proved that the theory upon which the new construction was based was correct. It is not at all difficult now to procure 150 per cent of the boiler rating with Iowa steam coal, and the units can be forced to

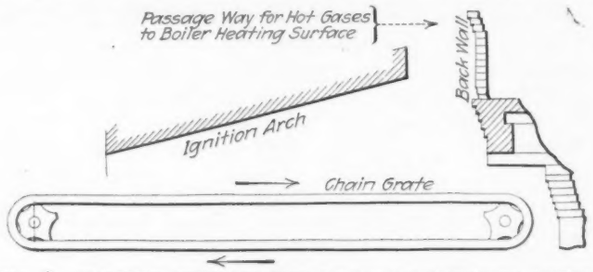


FIG. 2—MODIFIED FURNACE REPLACING ARRARGEMENT SHOWN IN FIG. 1

200 per cent of their rating with Illinois coal. During the course of these improvements the coal consumption per kilowatt-hour was reduced from 9.5 lb. (4.3 kg.) to 6 lb. (2.7 kg.).

Surprisingly better results were also obtained subsequent to changes in another Iowa plant, where a 500-hp. Edge Moor water-tube boiler, served by 110 sq. ft. (10.12 sq. m.) of grate area, was installed. As originally set up 300 hp. was the maximum rating which could be developed from this unit with Iowa steam coal. After changing the lengths and angles of the arch and the back wall, the installation was able to develop over 200 per cent of the boiler rating with the same fuel. The coal consumption per square foot of surface per hour was raised to 40 lb. (18.1 kg.) without interfering with the good quality of combustion.

In this instance, instead of leaving the back wall at the rear of the grate, standing vertically or sloping backward, the engineer rebuilt it so that it now slopes toward the front of the boiler and has its upper end about 3.5 ft. (1.1 m.) above the grate. The arch over the grate was also given an upward tilt and was made to end at about the same level as the top of the back wall and about 18 in. (45.7 cm.) from it. This arrangement forms a larger, high-center ignition chamber, with the white-hot surfaces reflecting more directly upon the burning fuel. The hot gases are led to the boiler tubes through the passageway between the back

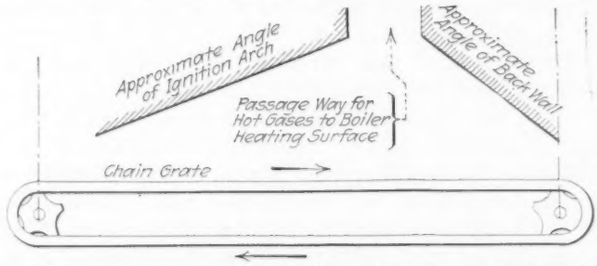

Approximate Angle of Ignition Arch
Approximate Angle of Back Wall
Passage Way for Hot Gases to Boiler Heating Surface
Chain Grate

FIG. 3—BACK WALL AND IGNITION ARCH SET AT ANGLES TO REFLECT HEAT BACK ON TO GREEN COAL

wall and the arch. The engineer believes that the increased rating and efficiency gained are due to the fact that reflection of heat from the modified back wall gives better conditions for ignition at the grate. In this furnace such high temperatures can be produced that the grates, if they are allowed to become bare, will be burned.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

CONVENIENT TAG FOR SWITCHES

Consists of a Leather Envelope Containing a Card Properly Arranged to Receive Full Information

Line construction and repair work is done by linemen reporting to headquarters. These linemen, working on street-lighting circuits or other circuits which must be interrupted for them, should be adequately protected against the possibility of the switch being inadvertently closed. Because of the fact that there is no regular operator in attendance this problem is difficult, but the following solution is suggested, after a trial of a number of years in several substations:

A leather envelope is used as a tag to be hung on the switch controlling the circuit to be protected. On one side of this envelope is printed the customary warning that men are working on the circuit. Within the envelope is a card properly arranged to receive full information as to the time the tag is placed and removed from the circuit, for whom it is so placed and for what purpose. The workman wishing to be protected makes his record on the card and hangs and removes the tag himself. Two or more gangs working on the circuit at the same time have equal protection, the last one to clear from the circuit removing the tag. The cards are collected from the substations at suitable intervals and become a record.

This suggestion was made by W. C. Pearce, superintendent electrical department Syracuse Lighting Company, in a paper read at the recent meeting of the National Safety Council.

INCREASING EFFICIENCY OF THE BOILER PLANT

More Mechanical Apparatus Advocated for Even Small Boiler Rooms—Need of Interpreting Instrument Readings

Methods of insuring maximum efficiency in steam boiler plants were discussed at a meeting of the Providence (R. I.) Engineering Society on Dec. 12. George F. Weaton read a paper advocating the use of more mechanical apparatus in plants as small as 1000 hp. The author maintained that a 1000-hp. plant, if equipped with three 350-hp. boilers, can be operated economically by two men and provide for equipment lay-offs. Fuel economizers, underfeed stokers, coal and ash conveyors and overhead coal storage are desirable even in a plant of this size, enabling the load to be carried on two units when necessary. The returns on such an investment may be less than in a larger station, but they will exceed those for a smaller investment and a simpler plant.

In lately designed plants of high efficiency the excess of oxygen required for combustion has been cut as low as 20 per cent and the boiler efficiency runs around 86 per cent. The controlling fireman should receive the highest wages of all employees in the station except the chief engineer. Every plant should have an Orsat or other hand-operated apparatus for flue-gas testing. Imperfect combustion is indicated by streaks of dark color obscuring the opposite sides of the furnace from the observer. Perfect combustion occurs at a temperature producing light which penetrates blue glass. The dun-colored gases arising from the fuel bed, upon entering the zone of perfect combustion, should disappear, leaving a clear lavender-gray color. A furnace temperature of from 2800 deg. to 3000 deg. Fahr. (from about 1500 deg. to 1700 deg. C.) indicates good conditions. The most accurate check is obtained by metering the feed water, accurately weighing the fuel, and by periodic readings of steam, feed-water and flue-gas temperature, etc. Any plant not equipped with means for measuring such quantities, unless it be very small, will waste enough to pay for the outfit required in a short time. The use of elastic cements on settings and of painter's putty around door-joints is recommended.

Present boiler-room labor is widely unsatisfactory, even at 32 cents per hour, but in a plant where coal passing has been subjected to scientific analysis the following conditions and results obtain: Coal dumped alongside the boiler house on the floor level of the latter is handled to stoker hoppers 8 ft. (2.4 m.) above and from 50 ft. to 150 ft. (15.2 m. to 45.7 m.) away. Two balanced barrows are used, each of 500-lb. (226.8-kg.) rating. By skillful loading a maximum of 700 lb. (317.5 kg.) has been attained on some occasions. In one day the operator handled 679.3 lb. (308.1 kg.) per trip, the run being over 35 ft. (10.7 m.) of paving, up an elevator and along 80 ft. (24.4 m.) of steel plate to the hopper. Fifty-nine trips were made, the average time per trip being 7.17 minutes and the total coal handled 40,800 lb. (18,506.6 kg.). At present five men handle about 190,000 lb. (86,182.5 kg.) in twenty-four hours, at an average cost of 21.5 cents per gross ton. This represents maximum economy, in the author's opinion.

MANAGERS MUST BE SHOWN VALUE OF IMPROVEMENTS

Discussing this paper, H. A. Wilcox said that lack of economy in the past and to-day is in part due to the unwillingness of many managers to spend anything on economy-producing equipment. This feeling has gradually undergone a change owing to the entrance of highly trained efficiency engineers into the field and to the retaining of expert engineers by the manufacturers of boiler-plant accessories. In a boiler plant of several thousand horsepower an allowance of two men per 1000 hp. is ample, but in a plant of only 1000 hp., the speaker considered, at least three men are needed—one man to operate the stokers, tend water, etc.; one to operate and maintain the coal and ash-handling machinery, and one to clean economizers, clean and re-

pair laid-off boilers, etc. Stokers of the mechanical type are favored, even for a plant of 1000-hp. boiler rating. Large combustion spaces are desirable, with maximum cleanliness. The present tendency is to increase the distance between boiler and grates, in order to prevent cooling the gases by contact with the comparatively cold heating surfaces before combustion is complete. Exposed portions of boiler shells, feed piping, etc., should be surrounded by asbestos covering. The grate must be adapted to the fuel to insure minimum loss of combustible material. Periodic lay-offs of equipment for inspection and cleaning and a frequent ash analysis are of great importance. Frequent use of gas-analysis apparatus and simple draft readings will check air infiltration, and the condition of baffles may be determined by flue-gas temperature study. The speaker queried the efficacy of inspecting the fire through violet glasses, on account of variations in the personal equation.

Mr. Wilcox favored the use of both Orsat and carbon-dioxide recorders, and also of a sampling tank for gases capable of covering considerable periods. Recorders of flue-gas temperature, drafts, amount of feed water, weight of coal, etc., are indispensable aids to fuel economy. All such instruments, however, are without value unless their indications are intelligently interpreted.

MANHOLE CONTAINING NO SPLICED CABLES

Chance for Cable Weakness Eliminated by Pulling Cable Two Ways from Manhole Without Cutting It

In laying out an underground cable system the Iowa Railway & Light Company of Cedar Rapids found it expedient to place the first manhole of the system about 25 ft. (7.6 m.) outside the power-house wall. This manhole as it appeared before the top was built is shown in the accompanying illustration. It will be observed that the cable passing through the hole con-

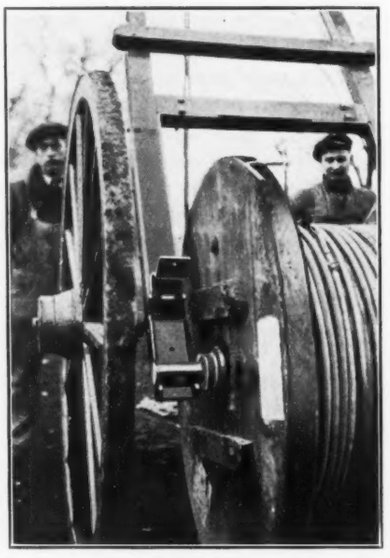
2300-VOLT CABLES PASSED THROUGH MANHOLE WITHOUT SPLICING

tains no splices. This unusual circumstance is the result of a desire on the part of the company's engineers to keep the cable as free from splices as possible. The work was accomplished in the following manner: The cable was first pulled from this manhole to the next one. This left just about enough on the reels to extend into the power house. The cable was then removed from the reel, doubled back on the ground, and the end was pulled into the ducts leading to the power house. The four concentric, two-conductor, cambric-insulated, lead-covered, 600,000-circ. mil., 2300-volt cables shown here have now been in service several months, proving that no damage resulted from this sort of handling.

CABLE CART THAT LIFTS ITS OWN CABLE REELS

It May Be Used for Hauling Cable, and It Also Saves the Time Usually Required to Set Reels on Jacks

A two-wheeled cart which will serve both as a cart and as a cable reel has been constructed by the electrical department of Lincoln Park, Chicago, under the



DETAILS OF THE LEVER CONSTRUCTION BY MEANS OF WHICH THE REEL IS EASILY PICKED UP

direction of Claude H. Shepherd, electrical engineer for the park. The cart consists primarily of a pair of 72-in. (182.91-cm.) wagon wheels, in which a special pair of shafts have been fitted. The shafts have been arranged so that when the end into which the horse will be hitched is elevated the other end can be slipped under a special mandrel which has been made to fit into the center of the cable reel. When the shafts are pulled down the hook on the short end of the shafts lifts the reel of cable, which then rolls down the shafts about 6 in. (15.24 cm.) into a groove (see illustration). This places the mandrel, which runs through the center of the cable reel, just back of the center line between the two wheels in such a position that the weight of the long end of the shafts is sufficient to keep them on the ground. The reel can then be fastened securely in place by hinges which fasten down over the ends of the mandrel with hand screws. With this cart two men can very easily handle a reel of standard-size cable in much less time than it can be handled on the ordinary type of jack.

The cost of constructing this cart was by no means of a prohibitive kind. The cost of material came to

$89.61, the cost of labor expense was $103.06, and the overhead charge was $14.27, making the total cost for the completed vehicle $206.94.

COMPENSATING LONG FEEDERS THAT ARE LIGHTLY LOADED

Accomplished by Inserting a Two-to-One Current Transformer in the Compensating Leads to the Contact-Making Voltmeter

In connection with the use of automatically controlled feeder voltage regulators of the induction type, the proper compounding of lightly loaded feeders of considerable length often presents difficulties. Such feeders require approximately full boost over the peak, not because of high load but on account of excessive drop due to length.

In any substation the feeders will usually be found equipped with current transformers of similar size, and with a lightly loaded feeder it will be found impossible to get full boost out of the regulator, even when the dial switches on the contact-making voltmeter are adjusted for maximum compensation. In such a case it is inadvisable to change the current transformer on the feeder, since such a change spoils the uniformity of the equipment, and, furthermore, the smaller current transformer may seriously limit the capacity of the feeder in case it becomes necessary to tie additional load to it in an emergency.

A better solution of this difficulty is the insertion of a two-to-one current transformer in the compensating leads to the contact-making voltmeter, with the 5-amp. winding connected to the feeder current transformer and the 10-amp. winding in circuit with the contact-making voltmeter. This practically doubles the compensation per unit of primary current and gives high boosts at relatively light loads.

COMBINING STATIC BOOSTERS WITH INDUCTION REGULATORS

Case in Which a Static Booster May Be Used to Improve Regulation, and How It May Be Done

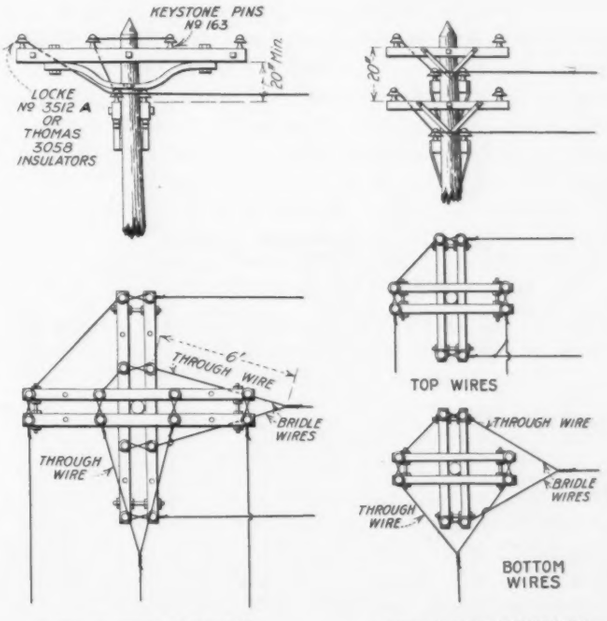
The use of static transformers as boosters is often a makeshift of great value in practice. However, it must be remembered that lines which require such boosters because of either excessive load or excessive length will be subject to poor regulation, for although a static booster raises voltage it does not improve regulation.

A case in which a static booster may be used to improve regulation is as follows: Where an automatic induction, feeder-voltage regulator is used on a line having a regulation in excess of 10 per cent and the bus voltage cannot be modified because of the necessities of other unregulated feeders connected to the same bus, the feeder will have insufficient pressure over the peak, even with the regulator at full boost, unless a regulator having a greater range than the standard plus or minus 10 per cent be obtained. In such a case a static booster boosting 10 per cent can be used in conjunction with the regulator to secure a range of full 20 per cent above the bus voltage. The contact-making voltmeter should be set to give 10 per cent under voltage. This will give full buck at no load, and the automatic regulator will counteract the additive effect of the static booster. As load increases this regulator will pass from full buck to full boost, giving a range of 20 per cent above bus voltage. If the bus voltage is variable and regulation desired on the feeder does not exceed 15 per cent, it will be advisable to use a 5 per cent booster, thus giving a range with reference to bus voltage of minus 5 per cent to plus 15 per cent.

PLAN FOR EQUALIZATION OF WIRE STRAIN AT CORNERS

How an Extra Bridle Wire Has Been Employed in Buck-Arm Construction to Prevent Corner Poles Twisting

On the transmission lines of the Southern Illinois Light & Power Company of Hillsboro, Ill., a novel plan has been worked out for equalizing wire strain at buck-arm corners. The standard line construction of the company is of two types. One of these types employs



DOUBLE-ARM CONSTRUCTION TO EQUALIZE STRAIN ON CORNERS

standard four-pin 10-ft. (3-m.) cross-arms, permitting the transmission lines to be strung with all three wires in a single plane. The buck-arms are so placed that the bottom of the top arm is never less than 20 in. (50.8 cm.) above the top of the buck-arm. With this arrangement it is necessary to dead-end two line wires on one end of the arm and one wire on the other end. In order to equalize the strain on the pole and on the arm, an extra 6-ft. (1.8-m.) bridle wire is employed as shown in connection with the hitherto empty pin.

The company's other standard type of construction employs two arms of the two-pin 4-ft. (1.2-m.) type, placing two wires on the top arm and a third on one pin of the bottom arm. The method of working out the same scheme on the bottom arm with this type of construction is shown in the accompanying illustration.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

METHOD FOR FIGURING THE MAXIMUM DEMAND

Chattanooga Company Using Wright Demand System Changes from Taking Lamp Census to Socket-Census Method

For the purpose of checking the actual connected load on the consumer's premises the Chattanooga (Tenn.) Railway & Light Company periodically takes a census of all lamps on its lines. The company uses the Wright demand system of charging for residential service, and therefore the demand has been based on the actual connected load as evidenced by the total wattage of the lamps installed. Owing, however, to the expense involved in keeping a complete record of consumers' lighting equipment, the company is changing this method to a socket rating. An average rating per socket of 50 watts is assumed. This figure multiplied by the total number of sockets gives the assumed maximum demand. The company takes 66 2/3 per cent of this latter quantity as representing the maximum demand for rate purposes.

MAKING PUBLIC-RELATIONS CAPITAL FROM TAXES PAID

How the Milwaukee Company Secured Valuable Unpaid Publicity Through Its Local Newspaper's Interest in Its Internal Affairs

When the Milwaukee Electric Railway & Light Company sent the State Treasurer a check for a part of the tax which it must pay to the various governing bodies a fac-simile of the check was given to one of the local newspapers, together with an article setting forth the company's position as regards taxation. The check was reproduced in the newspaper, with the following story:

On Nov. 30 the Electric Company handed to State Treasurer Johnson a check for $546,872.53 in payment of the State taxes of the company for the last year. This sum represents only what is paid the State as direct taxes and does not include any of the real estate, special or income taxes paid the federal government. It is an increase over those paid last of $36,433.94.

Of this sum $425,729.88 is paid on the property of the Milwaukee Electric Railway & Light Company, and $121,142.65 represent the taxes of the Milwaukee Light, Heat & Traction Company.

Of the taxes paid by the companies the city will finally receive 65 per cent, or $276,724.42; the county 20 per cent, or $85,145.98, and the State 15 per cent, or $63,859.48, this division being in accordance with the new State law. The total cash taxes of all kinds will amount to $612,290.47, State and federal.

This means that of the total operating revenue of both companies, commonly known together as the Electric Company, of $9,892,492.04 there is paid in taxes 6.18 per cent, and for every dollar of the net income of $1,463,077.96 there is paid in cash taxes 41.86 cents, or nearly one-half. Last year the ratio of such taxes to the net income was 21.1 per cent, but the greatly increased cost of operation and taxes with no increase in rates or fares this year raised the proportion to the high figure of 41.85 per cent. Few net incomes even with war profits are taxed so highly.

In addition to the amount paid the State the company will pay $65,517.94 for real estate and federal income tax. These figures include nothing for indirect taxes, such as paving, electricity to operate city bridges, street sprinkling and snow removal, or free passage of city policemen and firemen and other public employees.

This total paid in taxes means that every day the company must pay the State and nation $1,705.18 and that the fares of 57,300 passengers, at the average for original and transfer passengers of 2.98 cents each, must be taken for this purpose each day. This must be taken from the income before anything can be taken for its employees or other costs of operation, or for maintenance or interest on the investment.

During the year ended Oct. 31 the company carried a total of 177,515,482 passengers of all kinds, revenue, transfer and free, the latter composed of its own and various public employees, there being an increase for the year of 4.12 per cent. There was also a total of 57,880 electric service customers of all classes, commercial, power and residence, an increase of 12.95 per cent. The passenger revenue of the company increased 6.5 per cent; the railway operating expense including taxes increased 11.4 per cent. The electric service revenue increased 21.9 per cent, while the expenses are due to the higher cost of everything needed in operation.

PLAN FOR STIMULATING ELECTRIC VEHICLE INTEREST

Southern Central Station Stages in Its Show Window a Special Demonstration of Pleasure-Car Battery Charging

The commercial department of the New Orleans Railway & Light Company has been giving considerable attention during the last few months to the stimulation of electric vehicle business, in the effort not only to arouse more public interest but to secure a greater activity on the part of the local vehicle dealers. Several industrious distributers have taken on agencies for the best electric trucks and pleasure vehicles, and have found the market so responsive that they are enthusiastic over their experience so far.

In order to make it convenient for the public to get acquainted with the advantages of electric pleasure vehicles an arrangement was made with one of the local distributers to place an electric car on exhibition in the lighting company's showroom. This was a late model of particularly appealing design. At the same time, a complete line of storage batteries of different types and a special demonstration of "How to Charge Your Electric" were featured. Invitations were sent out by this local agent to a list of New Orleans people financially able to purchase an electric car, and the showroom was crowded daily with interested visitors inspecting the cars and discussing the advantages of electric vehicles.

ANOTHER CLASS GRADUATES AT DOMESTIC TRAINING SCHOOL

Union Electric's Courses Now Number 933 Women Fully Convinced of Economy of Electric Range Operation

Another course of ten weeks has just been completed at the domestic science training school of the Union Electric Light & Power Company, St. Louis, Mo. Out of 323 women enrolled 250 received diplomas. The fourth term opened Dec. 3.

The lessons in these classes have been chosen with special reference to the question of food conservation with the electric range as the cooker. Since last April 933 women have graduated from the courses, with a full conviction of the economical operation of the electric range.

The work carried on by the St. Louis company, if supplemented by similar work by other central stations in all sections, will have a direct bearing on the momentous question of coping with the food shortage that is a necessary accompaniment of the nation's participation in the war. The electric range properly mustered in and efficiently supported will acquit itself as a steadfast and dependable auxiliary of the electrical service brigade that is doing so much to help make the world safe for democracy.

CHICAGO ELECTRIC TRUCK SERVICE GARAGE FINISHED

A Contract, Including Transportation, Tires, Repairs, and All Garage Service, Is Entered Into Under a Single Monthly Flat Rate

The complete electric truck service for Chicago is now a reality. The Commonwealth Edison Company has erected a commercial electric service garage in the West Side wholesale and industrial district on the corner of Jackson Boulevard and Morgan Street. This new building has capacity for 100 vehicles. The new portion measures 125 ft. by 200 ft. (38.1 m. by 60.9 m.), and is built adjacent to an older garage used for some

FIG. 1—THESE SHOW WINDOWS FRONTING ON JACKSON BOULEVARD WILL BE USED TO DISPLAY NEW TRUCKS

of the company's cars. There are seventy-two additional charging positions in the old part of the building.

By the plan worked out a customer by paying a flat charge per month gets everything his transportation service requires except liability insurance and the services of a driver. Ordinary repairs, tires, battery renewal and charging, washing, garaging and painting are all covered by the contract. The only stipulation is that the contracting party must start with new electric trucks. The building was started in July and is now practically completed.

The one-story building is divided into two rooms,

FIG. 2—WHEN A DRIVER BRINGS HIS OWNER'S TRUCK INTO THIS GARAGE HIS DUTIES CEASE; THE VEHICLE GETS COMPLETE CARE FROM A TRAINED FORCE

each of which is served electrically by a standard Schafer switchboard. One of the rooms is used for the company's own trucks at present. Energy taken from the company's direct-current substations is distributed through these boards to fifty-eight charging positions in the two rooms. Each circuit, in addition to carrying the usual switching equipment, also has an individual rheostat and meter. The rating of most of the circuits is 100 amp., but some circuits to carry 200 amp. are installed for boosting. As will be observed from the illustrations herewith, the junction boxes are all overhead and A. & J. M. Anderson plugs are used throughout. The general lighting is of the steel reflector in-

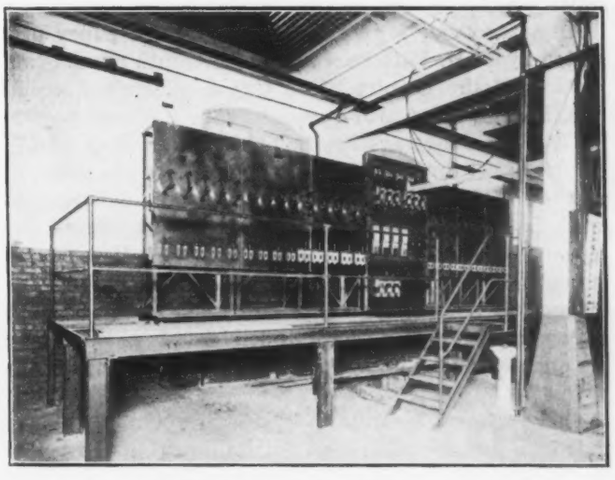


FIG. 3—ONE OF THE BLACK SLATE DISTRIBUTING BOARDS; THE OPERATORS' GALLERY HAS A SLATE FLOOR

dustrial type with special receptacles for the washing racks and with liberal window lighting at one side where manufacturers' truck displays will face the adjacent boulevard.

In selling the service which the company will offer through this garage it has been observed that many

vehicle owners do not know their exact costs. It is pretty generally conceded, however, that a 1-ton truck with Edison batteries doing an average amount of work day by day costs an individual $125 a month to operate from his own garage without counting driver's wages or insurance. When owners do know their costs they are often ready to concede that this truck service plan will save money for them. The sale of the service, of course, involves the sale of trucks, and four truck manufacturers are now co-operating with the Edison company's commercial vehicle men. They are the Walker, the Ward, the General Vehicle and the Couple-Gear companies. Since the Chicago campaign started Sept. 1, sixteen new trucks have been sold, of which ten are already delivered. The men in charge of the commercial-vehicle work stated that the prospects for more business appear particularly bright.

The total investment represented in this truck service station, including real estate, is $185,000.

RENDERING MONTHLY BILLS TO CONSUMERS

Ohio Association Receives Information from Members on Their Plans for the Exercise of Economy in This Direction

A little while ago the Ohio Electric Light Association made a request of its membership for information as to what companies were doing or proposed to do in relation to the increase of 1 cent upon each postal card that has been caused by the government war tax. A few responses have been received in answer to this request.

The Dayton Power & Light Company reports that it has for several years had its meter readers deliver about 90 per cent of its bills to its customers and would not return to the mailing system for this 90 per cent, as it finds the delivery system much more satisfactory.

An interesting suggestion is found in a paper presented by F. H. Patterson at the thirteenth annual convention of the Empire State Gas & Electric Association, held on Oct 5, 1917, as follows:

"The bill deliverers are paid at a flat salary of $14 per week. For this they are expected to deliver an average of 450 bills per day. For all bills delivered in excess of this they receive ½ cent per bill. As in the case of the meter readers, a penalty of 10 cents is imposed for each error discovered against the bill deliverers. Under this arrangement the average amount of compensation paid each bill deliverer is about $76.50 per month, and per bill delivered, exclusive of supervision, 0.659 cent."

The Pomeroy & Middleport Electric Company says that it will continue to mail out its light bills on postal cards, notwithstanding the increased cost. It feels that even at the advanced price the cost of service is lower and better than it would be if it had to furnish paper for printing the bills and make personal delivery in addition.

The Columbus Railway, Power & Light Company reports that it has used the postal-card form of bill for all light and power customers since 1913 and the arrangement has been extremely satisfactory. With the present change in postal laws the cost of mailing the postal-card bills will be doubled, and it is at this time making a study of the situation and endeavoring to find a means by which it will be enabled to eliminate the extra expense. One plan receiving its earnest consideration is that of leaving the bill on the premises when reading the customer's meter, by which the company believes it can eliminate the postage charge, together with a large portion of the cost of delivery.

The Greenville Electric Light & Power Company so far has taken the stand that it will continue the postal-card system at the increased rates, not only because of the efficiency and excellence of the postal delivery system, but also on the ground that this war has to be paid for and it might as well do its bit in that direction as in some other.

WIRING IMPROVEMENTS ARE REQUIRED OF CONTRACTORS

Worcester Central Station Has Posted a Bulletin Outlining Outcome of the Experience of the Company's Illuminating Department

To insure wiring installations in accordance with its convictions as to the best practice, the Worcester (Mass.) Electric Light Company recently posted a bulletin for local contractors covering the following requirements in all cases where central station service is provided. The points insisted upon are the outcome of the experience of the company's illuminating engineering department, and their inclusion makes each installation better from the standpoint of both the company and the customer: (1) Indicating switches are required on all interior lighting circuits. (2) Holes made at the building entrance must be carefully closed up to keep out cold, if too large for the conduit. This means fuel saving as well as increased comfort for the customer. (3) Ceiling pans are required to be fastened by means of crowfeet or insulating joints and not by screws through the edge of the pans. (4) Insulators are required by the company on pull-chains in all kitchens and baths and also in pantries having sinks, thus doing away in large measure and at trifling cost with claims for damages for shocks received in such situations. (5) Shades about 6 in. in diameter are required in kitchens where only one lamp is installed, in order to give a satisfactory general distribution. (6) In the past an insufficient number of pipe straps have often been used in outside attachment of conduit above the head of the wireman. Enough to insure rigidity are now required. (7) Brass pans of the two-light type are required to be at least 12 in. in diameter, using at least 14-in. diameter on three-light to five-light units, inclusive. The insistence upon these sizes improves the distribution and avoids the poorer service resulting from the use of smaller and less expensive units. (8) Contractors are required to furnish meter boards of good quality instead of using scrap boards from the cellars of buildings being wired. In one case before this ruling the contractor employed pieces of an egg crate, which failed to hold satisfactorily. In these regulations, issued from its counter where requests for wiring bids are displayed, the company did not intend to criticise the work of the local contractors as a class, but to catch up a few loose ends in wiring practice and point the way to betterments easily obtained.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Parallel Coupling of Three-Phase Transformers.—JACQUES DAMIEN.—After some theoretical considerations upon the relative advantages and disadvantages of three-phase transformers as influenced by the method of connection, the author concludes that star connections and delta connections are of nearly equal advantage from the points of view of construction, of insulation and of performance, and that from the point of view of coupling in parallel the advantage rests incontestably with the star-connected transformers. He lays down definitively the rules that should be observed in the construction of this kind of apparatus.—*Revue Gén. de l'Elec.*, Nov. 17, 1917.

On the Effect of Armature Resistance and Reactance on the Terminal Pressures of a Rotary Converter.—S. NEVILLE.—Continuation of an article which is concluded in this issue. Among the subjects discussed are resistance drop, pressure between direct-current brushes, pressure between adjacent polygon tappings, pressure between diametral tappings, reactance drop, inverted rotary and double-current generator.—London *Electrician*, Nov. 30, 1917.

Lamps and Lighting

An Integrating Hemisphere.—F. A. BENFORD, JR.—During the work of developing the compensating screen described in a previous paper the calibration of the instrument required the use of only one of the hemispherical halves of the integrating sphere. This suggested the permanent use of a hemisphere such as described in this paper. The sphere is well established as a photometric instrument, and the theories of the two instruments are compared to show that the hemisphere has certain theoretical advantages. The tests that have been completed confirm the calculated data. It was found necessary to correct for the lack of pure diffusion by the sphere paint, and the means of making this correction is described along with the absorption effects of the test unit in both sphere and hemisphere.—*Illuminating Engineering Society.*

Street Lighting with Modern Electric Illuminants.—S. L. E. ROSE and H. E. BUTLER.—This article on street illumination covers both incandescent and arc lamps from the illumination standpoint and gives charts facilitating the comparison of different units on the basis of illumination. It discusses the various factors entering into street-lighting contracts which should be thoroughly understood by all concerned in order to avoid controversies.—*Gen. Elec. Review*, December, 1917.

Generation, Transmission and Distribution

Practical Calculation of Electrical Transmission Lines.—B. GUERSCHINOVITCH.—Second part of a study on this subject, of which the first part was printed in the *Revue Générale de l'Electricité* for April 7; in the second installment the economic point of view is covered, with an elaborate compilation of formulas, largely based on the results already obtained.—*Revue Gén. de l'Elec.*, Nov. 10, 1917.

Relay Operation Under Heavy Short Circuits.—L. M. CRICHTON.—An analysis of tests by the Alabama Power Company to determine the reliability of the relays used under the following conditions: (1) low voltage due to a short circuit close to the substation; (2) poor power factor; (3) distorted phase relations due to unbalanced short circuit; (4) phase-angle error of the low-ratio ring-type current transformers which were installed in the circuit breaker bushing and which energized the relays; (5) energizing the relay potential coils from the low-tension side of the main power transformers, which were connected delta-star and consequently shifted the phase angles 30 deg.—*Elec. Journal*, November, 1917.

Traction

Utah Electrification Embodies Latest Developments.—Automatic substations with 1500-volt motor-generator sets and all-steel cars with equipment for automatic acceleration and constant-potential motor-generator sets for supplying energy to the control and lighting circuits are features of the Salt Lake, Garfield & Western electrification and extension.—*Elec. Railway Journal*, Dec. 15, 1917.

Catenary Overhead Construction.—W. C. LANCASTER.—Study of the design of the overhead system for the Montreal tunnel and terminal of the Canadian Northern Railroad.—*Elec. Railway Journal*, Dec. 8, 1917.

Notes on Steam and Electric Locomotive Performance.—F. WYNNE.—The author brings out several important comparisons of the performance of these two types of locomotives. He points out that the steam locomotive is a variable-speed machine, capable of developing practically uniform torque over a wide range of speed. The performances of several typical steam locomotives are given in curves. An excellent feature of the steam locomotive is its ability to develop any tractive effort within its capacity at a number of speeds below the maximum speed for that tractive effort. On the other hand, the electric locomotive is a variable-output machine, the developed horsepower varying with tractive effort demanded of it. The continuous capacity is limited by the temperatures which are safe for the continuous operation of the various parts of electrical equipment. Curves are presented giving the performance characteristics of direct-current locomotives with series motors, with commutating-pole series motors, with series alternating-current motors and with polyphase induction motors. Comparison of the curves indicates that an increased demand for tractive efforts in ascending grades or hauling greater tonnage will reduce the speed of an electric train with any type of locomotive less than that of a steam train. In addition, the reduction in fuel consumed with electric service is

enormous. The concentration of very much greater power in a single locomotive unit, the ability to operate two or more units with a single engine crew, and a resulting increased size of train, all tend to reduce the number of enginemen and trainmen required to produce a given amount of service electrically. A similar reduction in maintenance and inspection forces also leads to the elimination of secondary engine terminals, reduction in classes of repair men required and a smaller amount of repair work to be done.—*Elec. Journal*, October, 1917.

Installations, Systems and Appliances

A Swedish Hydroelectric Development.—This descriptive article, one of a series dealing with the state hydroelectric power houses of Sweden, takes up the installation at Porjus, of which the capacity is much superior to that at Trollhättan. Built upon the Lule River, it has a possible eventual rating of 700,000 hp. At the present time it comprises two single-phase generators of 12,500 hp. each, one three-phase unit of 14,000 hp. and one auxiliary set made up of a turbine coupled directly to two alternators, single-phase and three-phase. The project provides in the near future for five single-phase and five three-phase sets, each set operated by two turbines. The energy produced is transmitted at 77,000 volts and 8000 volts for the needs of a railway line and a mining company.—*Revue Gén. de l'Elec.*, Oct. 27, 1917.

Performance and Design of Surface Feed-Water Heaters.—M. C. STUART.—The writer develops his theory of heat transmission from the fundamental law that heat transmission is proportional to temperature difference. From this the writer proceeds to the determination of, first, the mean temperature difference between water and steam and then of heat transformation from steam to water. The validity of the theoretical relations between temperatures and tube lengths are demonstrated on multi-pass feed-water heaters by comparison with actual test data.—*Journal American Society of Naval Engineers*, August, 1917.

Turbo-Blowers and Turbo-Compressors.—V. OSWALD DAVIS.—The author points out the advantages of turbo-blowers and turbo-compressors over reciprocating steam and gas-engine-driven sets. Blast furnace turbo-blowers, turbo-compressors, efficiency of turbo-blowers and turbo-compressors and small turbo-blowers and exhausters are the topics discussed.—*Beama Journal*, October, 1917.

Electrophysics and Magnetism

Experimental Method of Solving Electrostatic Problems.—CHESTER W. RICE.—The electrodynamic method for solving electrostatic and allied problems has been developed to a high degree of accuracy and applied to the study of high-voltage bushings. An experimental high-air-efficiency bushing was built and tested with the result that the arc-over was very materially lower than had been anticipated. From a study made to ascertain the reason for this large discrepancy, it was found that an unexpectedly large surface effect, which varied greatly with different materials, existed. After obtaining the numerical value for the surface effect a reasonably accurate predetermination of the arc-over of structures in which the stress distribution is known can be made. In order to determine the desirability of using artificial equipotential surfaces to increase the efficiency of the use of the supporting dielectric, diagrams were taken and a small bushing of this type was constructed and tested. A study was then made to find out whether the reduction in diameter of condenser bushings is principally due to equalization of potential or to the greater strength of insulation when barriers are used. As a result of this work it is believed that the barrier effect greatly predominates. A short discussion shows the difficulties of obtaining a sufficiently exact theory of bushing design to make it possible to predetermine the most efficient shape for a practical bushing. A series of small bushings were tested with a view to determining the general shape and characteristics which go to make up a practical all-around bushing. An appendix gives an uncondensed solution of the following two-flow problems: (1) The distribution of the electrostatic field when any two confocal hyperboloids of revolution of one sheet and of the same family are maintained at given potentials; (2) the distribution of the electrostatic field when any two confocal hyperboloids of revolution of two sheets and of the same family are maintained at given potentials.—*Proceedings A. I. E. E.*, November, 1917.

Telegraphy, Telephony and Signals

Time Service in Switzerland by Telephone.—In Switzerland the complete suspension of private wireless installations at the outbreak of war caused considerable inconvenience to the watch and clock industry, which was accustomed to take its time from the wireless time signals issued from the Eiffel Tower. The difficulty appears to have been overcome by an automatic apparatus installed at Berne, which receives the wireless time signal and conveys it by telephone to those who so desire. It is said that the telephone transmission has proved quite successful, accidental errors in transmission being rarely more than one-tenth of a second.—London *Electrician*, Nov. 30, 1917.

Miscellaneous

Electrical Situation in Germany.—DR. NIEFIND.—A number of interesting sidelights were thrown on the electrical situation in Germany during 1917 by the annual convention of the Association of Electrotechnical Companies of Germany at Frankfort on the Main. The central stations of Germany use only 4 per cent of the total German coal consumption, so the association protests against the government orders curtailing the use of electric lights in homes and public buildings. Of the amount stated only 0.3 per cent is turned into electric light. Another part of the report dealt with the continued introduction of substitutes for materials considered "indispensable" in electrical work. It covered practically the whole insulating and conducting field from switchboards in central stations and high-voltage transmission lines to incandescent-lamp sockets and bulb bases with the ordinary insulated house wires. Good progress is reported in the use of aluminum, iron and zinc wires, as well as compressed and impregnated paper for insulating boards. An alloy of zinc has been discovered which combines ductility and toughness with fair electrical conductivity. In some cases it has been found feasible to use iron wires covered with a double coating of good varnish instead of the ordinary form of insulated wire.—*Elektrot u. Maschin.*, Nov. 11, 1917.

Readers' Views and Comments

Limiting Alternator Short-Circuit Currents

To the Editor of ELECTRICAL WORLD:

Sir: I was much interested in the article entitled "Limiting Alternator Short-Circuit Currents" which appeared in the issue of the ELECTRICAL WORLD for Sept. 8 last, and I should like to call attention to some of the points taken up.

The author states clearly that the subject is so complex "that anything like a simple explanation is difficult." This is true enough, but it is hardly an excuse for failing to give a "qualitative theory" within about the space taken up by the writer. It is stated "that the transient current is of much the same nature as that which flows when an induction motor is connected to the line. . . . In the present case the rotating field is the armature reaction, which is fixed in space, but rotates synchronously. . . . That the likeness exists only for a very short time, however, will soon be evident." There is little that is evident in regard to the above, and in fact the last statement is not quite correct. The likeness exists, not "for a very short time," but only so far as component *II* is concerned, as will be explained presently.

Following up the author's explanation and excellent scheme of "treating separately" the different causes and by superposition determining the "resultant effects," this is what happens: For the sake of convenience consider a two-phase revolving armature alternator, such as that described in the article. The armature reaction under sudden short-circuit conditions can be separated into the following: *I*. The armature field produced by the sustained short-circuit current and which is fixed in space, constant in intensity with respect to time and demagnetizing in regard to the field flux. *II*. A transient oscillatory decaying component similar to the one shown in curve *a*, Fig. 1. This was taken on a standard three-phase alternator, running at synchronous speed with the field unexcited and the armature suddenly connected to a three-phase supply. Curve *a*, Fig. 1, gives the emf. induced in a full-pitch exploring coil wound around the pole. Curve *b* gives the emf. impressed across one of the armature lines. The oscillating component of armature reaction is fixed in space and dies down according to the armature attenuation factor and is a function of the time angle Θ_1 with respect to the phase voltage at which the short-circuiting switch happens to close. *III*. The third component of armature reaction is a non-oscillating transient fixed in space (in case of the revolving-armature machine considered). The rate of decay of this component depends upon the field attenuation factor α_f, and is independent of Θ_1. For the sake of further clearness these three components of the armature reaction, with respect to the field and time, are shown in Fig. 2.

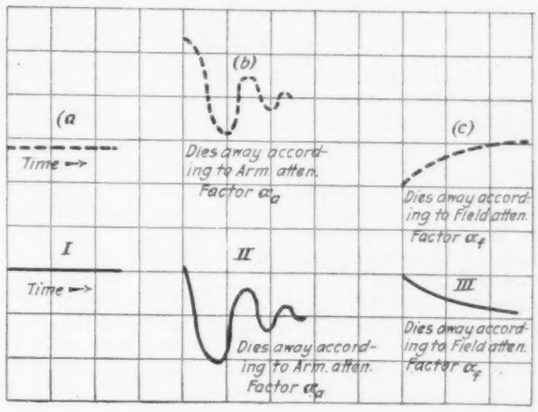


FIG. 2—COMPONENTS OF ARMATURE REACTION WITH RESPECT TO FIELD

The field flux now, in turn, has three components, as illustrated in Fig. 3 by *a*, *b*, and *c*. Component *a* is that due to the direct-current excitation. The oscillatory transient component *b* dies down according to the armature attenuation factor α_a, while the non-oscillatory component decays according to the field-damping factor α_f, and both *b* and *c* are independent of the time angle Θ_1 at which the short-circuit happens to occur.

Now the components *I* and *a* combine to give the small sustained short-circuit flux, which in turn is responsible for the sustained short-circuit component of armature current. As mentioned before, *II* is a function of Θ_1, and thus it may happen that it may neutralize *b*, in which case, of course, there is no resultant flux or emf. and no current produced by *II* + *b*; in the most favorable case of symmetrical sudden short-circuit armature current this is exactly what happens. Otherwise *II* + *b* gives rise to a unidirectional current in the armature which dies away according to the attenuation factor α_f. Finally *III* and *c* combine to produce a non-oscillating decaying flux, which produces an oscillatory current, decaying according to the field attenuation factor α_f.

The above represent the main reactions only and are approximate in that secondary effects are neglected and certain simplifying assumptions are made. The actual complexity of the reactions may be appreciated by referring to curve *c*, Fig. 2, which represents the voltage induced in a full-pitch exploring coil at the top of an armature slot. Curve *a* represents the field current while *b* gives the armature current. In this test an external resistance of 2500 per cent of the field resistance was suddenly inserted into the field just before short-circuit. A few such tests were made by the writer nearly two years ago, but as the results did not prove consistent enough, owing to the difficulty of controlling and duplicating the time of the closing of the short-circuiting switch, they were given up, and thus the writer feels that he is in

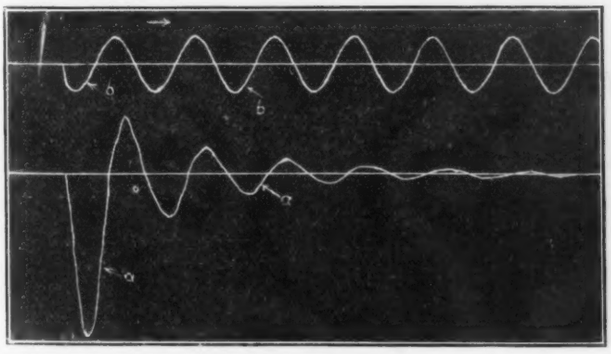


FIG. 1—EFFECT OF SUDDENLY CONNECTING UNEXCITED MACHINE AT SYNCHRONOUS SPEED

(a) First curve (from bottom)—voltage induced in full-pitch exploring coil around pole when three-phase alternator was suddenly connected across three-phase supply while running at synchronous speed and without excitation. (b) Voltage impressed across machine

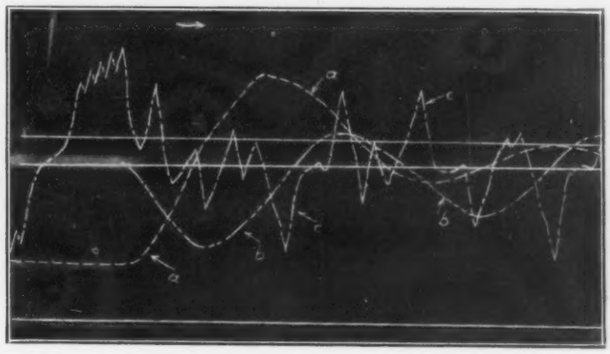


FIG. 3—CONDITIONS EXISTING IN MACHINE CIRCUITS BEFORE SHORT CIRCUIT

(a) First curve (from bottom)—field current. (b) Armature current. (c) Voltage induced in exploring coil at top of slot. From oscillographic record made just before sudden short-circuit. Before making this record external resistance had been inserted into the field circuit

a position to appreciate the interesting results given by Mr. Bown.

In regard to the effects of external resistance inserted into the field circuit, the author seems to be a little undecided, and states that it will have little or no effect on the initial value of armature current. External resistance in the field will always reduce the first peak of armature current, but to a small extent only, because it affects the rate of decay of $III + c$; i.e., it affects the field attenuation factor $\alpha_f = (r_f/x_f)$ only. Since α_f is small or x_f is large compared to r_f, the external resistance must be considerable to increase α_f sensibly. This also explains the limitation of external resistance in that beyond a certain point it will not affect much the total rush of armature current, since the components due to $I + a$ and $II + b$ are not affected by external field resistance. In this connection, to the possible beneficial effects of external resistance mentioned in the article I may add the importance of increasing the rate of decay of the armature current as a whole and thus lightening the duty imposed on oil switches and circuit-opening devices.

The effect of external inductance will be (unlike external resistance) to reduce the magnitude of the component of the armature current due to $II + b$ as well as the one due to $III + c$, though it will affect the latter to a greater extent than the former. Furthermore, external inductance will cause a decrease in the rate of decay of $III + c$, and, of course, it will not affect the dying away of $II + b$.

The author deserves credit for his automatic "synchronous short-circuiting switch, which can be closed repeatedly at any chosen point of the cycle." It is to be sincerely hoped that after perfecting such a device he will not fail to undertake extensive investigations along different phases of this important subject and do his bit to help solve some of the problems connected with it. I may be allowed in this connection to point out the great advantage of working with a two-phase machine, which is in many respects simpler than a three-phase one.

N. S. DIAMANT.

Rice Institute, Houston, Tex.

The Use of Iron Wire for Transmission Purposes

To the Editor of ELECTRICAL WORLD:

Sir: In the Oct. 13 issue M. D. Leslie presented some interesting operating data relative to highly loaded power distribution lines. Despite the statement in the latter part of your comment on the article, I am inclined to think that the fact that the iron wire itself had little to do with the charging current was not sufficiently emphasized. This current depends on the voltage, frequency, diameter and spacing of wires and the nature of the medium between wires, the physical qualities of the conductor material not being direct factors in the problem. In other words, the charging current of the lines in question would not have been sensibly different had copper wire been used. That the proximity of earth potential due to the iron poles affects the magnitude of the charging current but little is evidenced by the small discrepancy between the measured and calculated currents as given by Mr. Leslie.

Inasmuch as the line inductance is in series with the load, while the line capacity is in parallel therewith, it cannot be expected to be of much assistance in minimizing the charging current of lines of the physical dimensions of the ones described in the article referred to. The effective way to minimize these currents is by the installation of inductive apparatus at points along the line. In this connection it is well to point out, however, that the installation of such apparatus for the sole purpose of reducing transformer and line currents is likely to be attended with disappointing results, since the losses incident to the operation of such apparatus are quite likely more than to offset the energy savings resulting from decreased losses in the line itself. The real solution is to secure induction motor loads such as village pumping plants or other relatively low lagging power-factor loads. It is

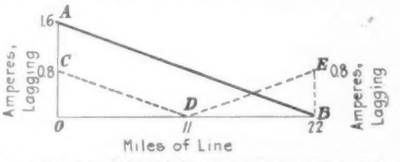


FIG. 1—DISTRIBUTION OF CHARGING CURRENT ALONG LINE

interesting to note that this is just the opposite of the type of load ordinarily desired by central station operators.

As noted in your comment, the experience of Mr. Leslie's company emphasizes in a most emphatic manner the desirability of carefully predetermining the operating characteristics of a proposed line of the type in question. In the present state of the art such predeterminations are not matters of great difficulty. While, as is well known, the current and voltage at any point of a transmission line are hyperbolic trigonometric functions of a complex angle whose value is dependent on the line length and other physical constants, ordinarily a few comparatively simple calculations will give results sufficiently accurate for estimating purposes.

For example, the distribution of the charging current on the high-tension side of the Dodge City-Mineola line described by Mr. Leslie is given without serious error by AB in Fig. 1. The distance from the base line to the line at a given point is to scale the current which an ammeter inserted in the line at that point would read if the load end of the line were open. It can be shown that resistance loss in a wire carrying a tapering current like the one under discussion is given by $1/3\ I^2r$ where I is the current corresponding to OA in the figure and r is the resistance of the wire. For a three-phase line the loss would be I^2r and for the line in question $1.6 \times 22 \times 12\frac{1}{2}$ or 705 watts. If now an inductive load taking 0.8 amp. at zero power factor, lagging, be connected to the load end of the line, the current distribution, without reference to phase position, will be as indicated by CDE. With this distribution the losses will only be one-half of the

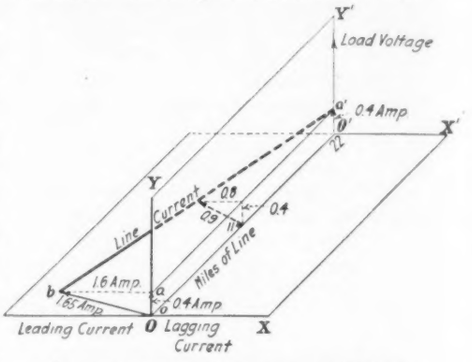


FIG. 2—PHASE AND MAGNITUDE OF CHARGING CURRENT WITH UNITY-POWER FACTOR LOAD

above figure, and further, it can be shown that this is the distribution which gives minimum line loss. While the presence of a power component of current modifies the statement to a certain extent, nevertheless it is roughly true that when the current at the load end contains a lagging component equal to one-half of the charging current of the line the condition will be that of minimum line loss.

By the use of two planes intersecting at right angles the distribution of the current along the line both as to magnitude and phase position can be shown graphically. Approximate distributions for a 15-kw. load, both at unity power factor and for the power factor which gives minimum line losses, are illustrated in Figs. 2 and 3. In these figures, O-O', the line of intersection between the two planes, is to scale the line length. The line current at any point, as for example the half-way point, is found by drawing, in the manner indicated, a line from O-O' to the line marked "line current." It is at once apparent that the average line

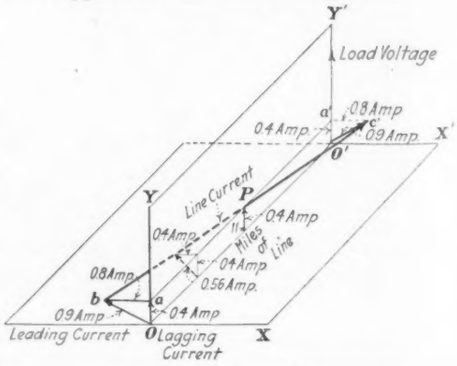


FIG. 3—PHASE AND MAGNITUDE OF CHARGING CURRENT AT POWER FACTOR GIVING MINIMUM LINE LOSS

current in Fig. 3 is much lower than that in Fig. 2. The power components of current, (component in phase with the load voltage) are shown in the OY plane, and the lagging and leading components are drawn parallel to the OX

plane, lagging currents being drawn to the right of the *OY* plane and leading currents to left.

D. D. EWING,
Associate Professor Electric Railway Engineering, Purdue University.

"Saving Derived from Covering Steam Pipes"

To the Editor of ELECTRICAL WORLD:

Sir: In the Oct. 6 issue of the ELECTRICAL WORLD, under the above title, is an article containing this statement: "This firm has covered all of its power piping, carrying 150 lb. pressure and 120 deg. superheat, with two layers of asbestos millboard ⅛ in. thick . . . designed to withstand the high temperature to which it is subjected. The purpose of using two layers is to completely fill the air space which would otherwise exist under the outer molded insulation."

Surely this practice represents a lot of needless trouble. In the first place, if 85 per cent magnesia coverings are properly made and specified to fit a standard pipe, there should be no "air space," or at least so small a space that it would be negligible because of the outer layer of 85 per cent magnesia, which would effectively retain any heat that had radiated into the space.

Whoever recommended "asbestos millboard" for such a purpose was evidently not aware of the fact that such a covering has not enough insulation value to warrant so expensive and so laborious a procedure. It is a common fallacy among engineers and steamfitters to refer to pipe covering as "asbestos," when all the while they mean something else. Asbestos *per se* has little or no insulation value, although it is a valuable fireproofing material. In loose, fibrous form it acts as a dead-air holder and so has some value as a heat insulator, but used as millboard it would allow the heat to pass almost as readily as if it were not there.

In the manufacture of 85 per cent magnesia coverings a small proportion of fibrous asbestos is used but merely as a binder, in the same way that hair is used in lime plaster for walls. It serves only to give structural strength and is not considered as contributing to the well-known insulating qualities of this covering.

In the second paragraph of the article "asbestos magnesia cement" is mentioned. I do not find this listed in any manufacturer's catalog. Is it a new material or merely another misuse of the much misused term "asbestos"?

Evidently it has been impressed on some one that 85 per cent magnesia coverings need protection from high temperatures? No practical engineer would countenance such an absurd proposition. Steam at 150 lb. pressure and 120 deg. superheat has an initial temperature of 478.5 deg. Fahr., while 85 per cent magnesia coverings are today and have been for years giving efficient service at temperatures up to around 600 deg. Tests made by independent authorities show no loss of insulation efficiency at temperatures far in excess of these figures. Furthermore, this efficiency is permanent, 85 per cent magnesia coverings tested after more than twenty years' service having shown no apparent deterioration in efficiency nor alteration of structure due to heat action.

Without questioning the figures quoted to show the (theoretical) efficiency of this installation, I believe that far better results would have been obtained, judging by the actual tests of coal economy, had these superheat pipes been covered by a double-standard thickness of 85 per cent magnesia, as advised in the official specification of the Magnesia Association of America, an association of the leading manufacturers of 85 per cent magnesia coverings formed for the especial purpose of supplying accurate data on pipe and boiler coverings.

AUSTEN BOLAM.
Prince's Bay, S. I., N. Y.

Difficulties Encountered in Utilizing Screenings

To the Editor of ELECTRICAL WORLD:

Sir: Screenings at one time were very low in price because apparatus was lacking to burn them, there was little demand, and they were considered as a useless fuel. To-day screenings have risen so in price that still lower grades of coal are being used and apparatus is being developed for them.

For some time now the uniformity of size of screenings has been getting worse, becoming less uniform, until today in many places the specified size of screenings may constitute only a minor percentage of the shipment, the remainder being of smaller sizes down to the dust. The reason for this may be the haste with which coal is being taken out of the ground. But the result is certain—lower combustion efficiencies, greater difficulties of firing, increased loss due to carbon content in the ash, and less coal delivered owing to loss in transit and handling.

The size of coal and the percentage of different sizes plays a large part in furnace, stoker and boiler performance. Variation over wide limits in the same shipment and different shipments from the same place makes performance variable and firing difficult. Dust and small sizes are very useful for banking purposes and may be used to good purpose on grates designed for them, but when used in conjunction with larger coal—1-in. (2.54-cm.) and 2-in. (5.1-cm.) screenings—result in waste of heat and coal.

The remedy seems to be to insist upon more uniform deliveries or modify the price. Dust and small screenings are acceptable—any coal is acceptable at this time—but surely screenings are too expensive already without paying for a large portion of dust at the same price. Many large users and many smaller ones now purchase coal on specification, although this practice has been held in abeyance lately on account of the fact that any sort of coal obtained anywhere is the object sought. However, when conditions revert to normal, but with the use of low grade fuels seriously and definitely established, it would seem worth while to adopt specifications that shall deal not alone with volatile matter—moisture, ash, sulphur, etc.—but shall also specify the percentage of dust and of sizes other than the nominal permitted. Screenings have now become sufficiently expensive without paying for dust at the same price, particularly since the same quality of dust when purchased alone may be considered a low-grade fuel, for the consumer could with advantage mix the two grades himself instead of paying for them at the higher price.

There is another phase of this matter. Coaldust absorbs a greater quantity of moisture and more rapidly than lump coal. It is not uncommon for Illinois coals to absorb in wet weather 10 to 20 per cent and give up during windy and dry weather 2 to 3 per cent of their weight during fifteen days in travel. Where mine weights govern the coal and freight bills the additional weight due to moisture matters little, but where either freight or fuel bill is dependent upon delivery weights the consumer may have to pay for moisture picked up in transit. Freight rates and fuel are costly enough without paying for water, and it would seem that as low-grade fuels and coaldust come more and more into use methods should be employed to protect them from the elements during the rainy months. It must also be remembered that lump coal can be shipped with fair efficiency in box cars or any type of car, whereas the finer coal and dust must be transported only in gondolas that are in good condition, otherwise there will be appreciable loss due to spilling and wind.

The absorption of moisture by coal of small sizes is not only objectionable because of the high price paid for water in such cases, but if this coal is to be stored the presence of moisture tends to encourage spontaneous combustion. Perhaps the greatest objection to absorbed moisture is that it must be evaporated by the furnace heat and raised to the temperature of the furnace gases.

GILBERT RUTHERFORD.
Evanston, Ill.

Burning Coal While Water Power Runs to Waste

To the Editor of ELECTRICAL WORLD:

Sir: In your issue of Nov. 10 I was much interested in the letter from Mr. Nichols. It does seem strange that we should continue year after year to burn up our coal and let water run to waste. I have thought for a long time that every drop of water that went over Niagara Falls should be used for development of electrical power. I am sure the Falls "dry" would be as much of a curiosity as they are "wet," and the use of the water would not necessarily mar the present attractions of the whirlpool and rapids. I hope I shall live to see the day when this power is utilized.

A. D. T. LIBBY,
Consulting Engineer Splitdorf Electrical Company, Newark, N. J.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

TO REDISTRIBUTE THE NIAGARA FALLS POWER

Conferences Between American and Canadian Authorities Lead to Agreement Which Will Allot Energy to Specific War Industries

Formal orders have been issued at Washington that no new war contracts shall be placed in Buffalo before the War Industries Board certifies that there is sufficient power for their manufacture. This is the outcome of conferences to consider the acute power situation at Niagara Falls, reported in last week's issue of the ELECTRICAL WORLD.

Assurances have been given to the Canadian government that approximately 100,000 electric horsepower imported from Canada will be used only for the manufacture of war products.

The War Industries Board is developing plans, which are now partly in effect in Buffalo, for a redistribution of electric power supply. It is proposed that industries of lesser importance in the war program shall receive power when it is not needed by war order consumers. To some extent the power received by industries of less importance, totaling about 110, will be curtailed.

Canadian authorities were unwilling that Canadian power should be sold to American non-war factories when factories on their side of the river are not receiving all the energy they need.

It is part of the plan that industries in Rochester, Syracuse and other cities shall also be restricted in their use of Niagara power so that Buffalo industries shall have more for their requirements.

FOLLOWING THE ORDER FOR "LIGHTLESS" NIGHTS

Widespread Co-operation Indicated by Reports Received at Washington—Sweeping Authority Is Given to State Administrators

Directly after the first practical experience with the so-called "lightless night," reports received at the United States Fuel Administration in Washington indicated widespread co-operation.

In a ruling telegraphed to Texas officials the Fuel Administration held that the electric sign order covers all light operated by any fuel, including oil and natural gas.

The United States Fuel Administrator, replying to an inquiry from Administrator Prudden of Michigan, said:

"If you decide it to be necessary in order to meet domestic consumers' needs, issue order closing some or all industrial plants, theaters, halls and places of amusement during the holidays."

This action of the United States Fuel Administrator follows the general policy of giving local fuel administrators ample authority to handle local fuel emergencies as they may develop.

Similar authority has been given to the New York State Fuel Administrator.

GOVERNMENT IN CONTROL OF RAILROAD OPERATION

Proclamation of the President Leads to Hope of Improvement in Coal Situation—Attitude on Electric Facilities

Complete federal control of the railroads, under the President's proclamation of Dec. 26, is of immediate importance because of its promise of improvement in transportation. Individual operation did not produce the measure of co-ordination which will be possible under sweeping governmental authority. It is evident that the federal Fuel Administration is looking to government control of railroad operation to improve the facilities for coal transportation. That result would be of immeasurable relief to electric central stations as well as to all other coal consumers.

The proclamation brings within government control the electric power facilities of electrically operated trunk line railroads and terminals. Evidently it also includes the contractual relations under which privately owned central stations furnish energy to such railroads. It embraces "every system of transportation and the appurtenances thereof * * * whether operated by steam or electric power."

After naming William G. McAdoo (who continues also as Secretary of the Treasury) to be Director General of Railroads, the proclamation adds:

> Nothing herein shall be construed as now affecting the possession, operation and control of street electric passenger railways, including railways commonly called interurban, whether such railways be or be not owned or controlled by such railroad companies or systems. By subsequent order and proclamation, if and when it shall be found necessary or desirable, possession, control or operation may be taken of all or any part of such street railway systems, including subways and tunnels, and by subsequent order and proclamation possession, control and operation in whole or in part may also be relinquished to the owners thereof of any part of the railroad systems or rail and water systems possession and control of which are hereby assumed.
>
> The Director shall, as soon as may be after having assumed such possession and control, enter upon negotiations with the several companies looking to agreements for just and reasonable compensation for the possession, use and control of the respective properties on the basis of an annual guaranteed compensation above accruing depreciation and the maintenance of their properties, equivalent, as nearly as may be, to the average of the net operating income thereof for the three-year period ending June 30, 1917, the results of such negotiations to be reported to me for such action as may be appropriate and lawful.
>
> But nothing herein contained, expressed or implied, or hereafter done or suffered hereunder, shall be deemed in any way to impair the rights of the stockholders, bondholders,

creditors and other persons having interests in said systems of transportation or in the profits thereof to receive just and adequate compensation for the use and control and operation of their property hereby assumed.

Regular dividends hitherto declared and maturing interest upon bonds, debentures and other obligations may be paid in due course; and such regular dividends and interest may continue to be paid until and unless the said Director shall from time to time otherwise by general or special orders determine. And, subject to the approval of the Director, the various carriers may agree upon and arrange for the renewal and extension of maturing obligations.

The order of the President became effective on Dec. 28, 1917.

Aside from his public career, Mr. McAdoo is widely known as the father of the Hudson River tunnel system operated by the Hudson & Manhattan Railroad Company and connecting New York City with New Jersey.

NO ADVANCE NOW IN THE NEW YORK EDISON RATE

Difficulty of Determining Effect of Conditions in War, Fuel and Labor Stated Before Public Service Commission by Mr. Lieb

No advance will be made in electric rates by the New York Edison Company for several months, probably for at least another six months. This was announced by J. W. Lieb, vice-president, before the New York Public Service Commission on Dec. 24.

If the company, however, experiences in the next few months a decided falling off in business and a reduction in income as a result of orders of the Fuel Administration or from other business conditions, it may find it necessary to appear before the commission and ask for a restoration of its former maximum rates, either 7½ or 8 cents per kilowatt-hour. The maximum rate is now 7 cents per kilowatt-hour. That rate was put in effect on July 1 last, following extensive hearings before the commission on the application of the company to maintain for another six months its 7½-cent rate, put in effect on Jan. 1, 1917, when a reduction was made from 8 cents. Under the present schedules by general understanding a rate is maintained for about six months, the formal proceeding in reference to the rates of the New York Edison Company and the affiliated United Electric & Power Company being kept alive by the commission for this purpose.

Mr. Lieb said that statements which had been made on behalf of the company last June as to the condition of business and prospects in the next six months had been described as unduly pessimistic, but that it was now known in general that the worst feared had developed and in increased measure. He said in part:

The situation is most difficult and uncertain, but as the year has not ended we are unable to furnish figures which will tell what happened in 1917 and will permit conclusions as to 1918.

We know that the company has had no considerable acceleration of business due to the reduction in rates six months ago, nor has it yet felt the full depressing effects of the general business situation. Nor has it yet developed to what extent conservation of fuel will be directed by the Fuel Administration and how far and how deeply this will affect business and income.

One of the things that we looked for last summer as possibly having a serious effect is not yet in effect, namely, the daylight-saving plan, but it now looks as if this would be put through Congress as one of the early measures at the President's request. The situation as to coal and labor is most disconcerting. It is impossible to make any coal contracts. Big producers will not consider them. The labor situation is disquieting. I have found it necessary to make notable advances recently in our payroll.

The situation is uncertain and we do not know how badly off we are going to be. We would rather not guess when we present our situation here. We desire to do so with facts and definite statements, and as we cannot produce facts and make definite statements at this time, it is the company's suggestion that the case should be postponed for six months with a privilege of making advances if it should be necessary.

Chairman Oscar S. Straus and Commissioner Travis H. Whitney, by questions to Mr. Lieb, obtained the statement that the company would not make increases without giving notice of at least thirty days. The hearing was adjourned to June 3, 1918, with the understanding that the rate will remain at 7 cents, unless the company finds its income so reduced by high costs of manufacture or by Fuel Administration orders, or both, that application for leave to restore the old rates would necessarily be made earlier.

GOOD-WILL MESSAGES TO MEN AT THE FRONT

Public Service Corporation Employees in Military Service to Receive Evidences of Regard from Fellow-Workers

Employees of the Public Service Corporation, Newark, N. J., are sending messages of appreciation and goodwill to all fellow employees in military service. The plan is to send a copy 7½ in. by 10½ in. (19 cm. by 26.6 cm.) in size to the home of the employee, and another, measuring 4½ in. by 5½ in. (11.4 cm. by 13.9 cm.), to the man at the front.

(NAME TO BE ENGROSSED HERE)

TO YOU, OUR FELLOW MEMBER OF PUBLIC SERVICE, WHO HAVE JOINED "THE COLORS", WE EXTEND OUR HEARTY GREETING.

YOU HAVE OFFERED YOURSELF FOR THE DEFENCE OF OUR COUNTRY AND OF THE PRINCIPLES UPON WHICH THE PROGRESS AND HAPPINESS OF HUMANITY ARE FOUNDED.

YOU HAVE LEFT LOVED ONES, FRIENDS AND CO-WORKERS, SO THAT THESE PRINCIPLES MAY BECOME A HERITAGE TO THEM.

WE, YOUR FELLOW WORKERS, ARE NOT INSENSIBLE TO THE SACRIFICES YOU HAVE ALREADY MADE, NOR TO THE ARDUOUS DUTIES THAT THE FUTURE WILL DEMAND.

THEREFORE, WE HERE EXPRESS A SMALL PART OF OUR APPRECIATION TO YOU, OUR FRIEND.

OUR THOUGHTS ARE WITH YOU AND, WHEN GREAT COURAGE IS NEEDED, MAY THIS EXPRESSION OF OUR LOVE AND CONFIDENCE STRENGTHEN YOU.

WE COMMEND YOU TO DIVINE CARE UNTIL YOU RETURN TO US—YOUR MISSION ACCOMPLISHED.

PRESIDENT.

A MESSAGE FROM THE HOME COMPANY

At the top of the message are the national flag and the service flag, printed in colors. Under the emblems the name of the man will be engrossed. Then will follow the engraved messages, signed by Thomas N. McCarter, the president. The Public Service emblem at the bottom will be in red, blue and gold.

INCREASING POWER DEMAND FOLLOWS WORK ON MUNITIONS

Many Plants Being Converted for Munitions Supply, and This Tests Capacity of Central Station Energy

In the following bulletin, dated Dec. 22, the electrical division of the War Industries Board indicates that many plants are being converted to munitions work and that this is reflected by increasing demands for central station energy:

Although the government departments will operate at regular speed through the holidays, we have had relatively a quiet week, owing to the lesser number of visitors from companies operating for the government.

No doubt many intended trips have been postponed because of inability to obtain accommodations out of Washington. During this period we have been able to arrange our records and data in much better shape for prompt action.

There is no indication of lessening demand for war purposes. but rather an atmosphere of increasing speed. On the other hand, the industry no doubt possesses capacity in excess of direct government needs. Our question, therefore, is, will the indirect demands from secondary sources absorb your available capacity? Many plants are being converted to munition work of one kind or another, and this in turn is reflected in demand for power almost beyond the capacity of some of the central stations to supply.

SHORTAGE OF POWER FOR BALTIMORE INDUSTRIES

Enforced Policy of Not Storing Reserve Supply, Coupled with Low Water, Brings Crisis in Electric Service

Coal shortage and deficiency in water power became so serious in Baltimore recently that the Consolidated Gas, Electric Light & Power Company was obliged to require industries using electric power to reduce their consumption greatly and in many cases to limit the use to lighting purposes.

President Herbert A. Wagner, in a statement to the public, said that the company had been assured repeatedly that its coal requirements were being taken care of. Nevertheless, it had not been permitted to accumulate any coal in reserve for contingencies. A subsequent statement by Mr. Wagner added:

Referring to the coal supply situation as affecting the power for the Baltimore industries, we are glad to say that coal is coming in now at nearly the normal rate and there is enough coal in sight for several days' supply. Owing to the vigorous action of the United States Fuel Administration, we have fairly definite assurances that the supply in the future will be sufficient and that we shall be permitted to accumulate a reasonable reserve for contingencies. The necessity for a reasonable reserve supply has been urged upon the United States Fuel Administration for the past few months, without result until to-day.

It should be understood that the company is consuming for the production of electric power over 1000 tons of coal a day, and that at the time the large industries were notified to reduce their consumption the company only had sufficient coal on hand to operate about six hours. A large part of the time of the officials of the company has been devoted for the last few months to assure a continuous supply of coal, but the priority orders which the company has been enabled to get through Washington did not permit of any reserve stock of coal to provide for just such contingencies as have come about in the last two days, during which the cold weather has seriously interfered with local delivery.

In the efforts of the management to obtain coal from other mines than its regular source, the poor quality of coal has damaged some of its boiler furnaces and further handicapped it in its power supply. Coincidently with these troubles the water supply from the Susquehanna River has been reduced by the cold weather below that ever recorded for this time of the year.

The imperative need of a reserve coal supply for the Consolidated company to meet the war demands in Baltimore and the fact that the United States government is now fully aware of this are clearly shown in a communication from Eugene Meyer, Jr., of the War Industries Board to United States Fuel Administrator Garfield. In this communication Mr. Meyer calls attention to the fact that the coal supply of the company has been taken care of "only to the extent of hand-to-mouth requirements. When the company gets a few carloads ahead the coal company immediately cuts off a supply equivalent to that stock."

At the time this statement was issued practically all of the industries in Baltimore were getting their full complement of power.

PITTSBURGH POWER DEMAND LARGELY EXCEEDS CAPACITY

Abnormal Consumption Due to the War Loads Generators in Some Cases 20 to 30 Per Cent Above Rated Capacity

Shortage of power in the Pittsburgh district and the consequent urgent necessity for economy in the use of energy has led the Duquesne Light Company to issue the following statement:

So many people without knowledge and without facts are talking about what they think the Duquesne Light Company is capable of doing in the way of furnishing electricity for power for industrial plants and street railway operation that a statement on our part seems necessary. Every industrial plant in the Pittsburgh district which is capable of making anything needed by the government to help win the war is being forced to the limit to speed up output. This has resulted in a demand upon the Duquesne Light Company for power about twice as great as it was a few months ago. This abnormal consumption has brought about a situation where we are called upon to deliver to our customers during the day a maximum demand largely in excess of our total generating capacity.

In other words, every generator that we possess, and all are in first-class working condition, is working beyond its capacity from 7 a. m. continuously, excepting only the noon hour, until 8 p. m. In fact, in some cases our generators are working 20 to 30 per cent above rated capacity. Anticipating a large increase two years ago by reason of the prosperity of the Pittsburgh district, but never figuring upon such a sudden and abnormal demand as is now imposed by increasing war orders, we contracted for one 40,000-kw. generator and one 15,000-kw. generator. The 15,000-kw. generator has been in operation, but delivery of the 40,000-kw. generator has been delayed over one year in spite of anything we or the manufacturer could do and it is only now being installed.

This machine will be placed in operation within a short time, as we are working night and day to hurry its installation. This will only relieve the situation in part, however, as it will largely assume the work of other generators in our power plants that have been badly overloaded.

Our first duty is to comply with government instructions and furnish all of the electric power that we can to permit munitions plants to increase their output. We are doing everything humanly possible to fulfill this obligation to the country and at the same time take care as far as we can of the needs of our consumers who are producing material which the government considers non-essential to win the war. We will be compelled, however, to curtail the amount of electric energy furnished to many of these, especially during the day.

Unfortunately there are many people who have not yet realized that war imposes sacrifices upon all of us. We are

not curtailing service and thereby reducing our revenue for the pleasure of it. This is a time when every one must cooperate to prevent waste in the use of electricity. It is a time when every effort should be made to help and not obstruct. The Duquesne Light Company will do everything in its power to render proper service to every one as far as the unusual war conditions will permit.

Those who can do so should operate as far as possible at night, when the present consumption is not nearly as great as our operating capacity. If our customers will do this and eliminate as much waste during the day as they can they will help a great deal to improve a situation over which we have no control. At the same time they will be doing their part to assist the United States to adequately prepare to win a decisive victory over the nation's enemies.

POWER SHORTAGE IN OHIO IS DUE TO LACK OF COAL

Electric Service Has to Be Withdrawn from a Number of Plants in Cleveland—Conditions at Other Points

Because of scarcity of coal the Cleveland Electric Illuminating Company was compelled to withdraw power and light service from a large number of industrial plants (estimated at 1800 by some) on the evening of Dec. 14. On the following evening the company announced that, operating in this limited way, its supply would not last more than two days, but that coal had been shipped and should be received in time to avert the danger of closing down entirely. Tenants of office buildings and stores were asked to use as few lamps as possible until full service could be restored.

Energy for the greater part of the Cleveland railway system is furnished by the illuminating company, and the prospect of being without light and railway service was alarming to business interests, while 75,000 or 100,000 people were thrown out of employment temporarily.

Receipt of a supply of coal prevented the Columbus Railway, Power & Light Company from closing its plants on Dec. 11. Plans are being put into operation by the company to reduce fuel consumption as much as possible. Railroad service will be cut about one-half after 7 p. m. The skip-stop plan will be adopted for residence sections and some re-routing of cars will be done.

The Hamilton light and water plants had little coal on Dec. 12, and street lamps were turned off that evening until an additional supply could be secured.

The Springfield Light, Heat & Power Company withdrew service from all industrial plants on Dec. 10 so that it would be able to furnish steam heat and power to the business district. Coal supply ran so short that the company feared to operate plants at normal.

Electric roads at Hamilton and Dayton were affected and several interurban railways were compelled to reduce schedules in order to continue operation at all. In some instances limited cars were taken off and in others most of the local cars were held in carhouses.

Gov. James M. Cox about the middle of the week demanded of the federal government a release of coal consigned to lake shipment.

The Northwest draws almost its entire coal supply from Pennsylvania, Ohio and West Virginia coal fields, and most of this is shipped by lake from Ohio ports. If sufficient supply is not sent in this way the Northwest runs short, and that would have been the case this season. Should the winter prove severe it is believed that the supply shipped will be none too large.

However, it is suggested by Ohio observers that the Federal Fuel Administration did not understand the effect that the inflexible priority order would have on points closer to the coal fields. None of the consumers stored the usual coal stock reserve. This was due to the high prices that prevailed early in the spring and to the advice given by authorities who considered quotations too high. Prices were run up by buyers who bid against each other.

The Cleveland Electric Illuminating Company received about 125 cars of coal on Dec. 16, a portion by boat from Lorain and the remainder by rail from orders which had already been placed. Plants closed down the previous day for lack of coal were able to resume operation in full.

The situation is not reassuring at all, but the authoritties are exerting themselves to furnish coal needed for future operation and prevent danger of shortage in energy, which is urgently needed in Cleveland to keep industries moving.

For a short time the Northern Traction & Light Company, Akron, was almost out of coal, but it managed to keep plants in operation until a small shipment was received.

While the supply is not expected to be so plentiful as in the past, it is hoped that within a short time the pooling plan established by the coal operators will bring about regularity of delivery and increase the efficiency of the railroad equipment.

NEW ENGLAND COMPANY CURTAILS POWER SERVICE

Coal Shortage, Combined with Unfavorable Water Supply Conditions, Makes Restriction of Energy Sales Necessary

Curtailment of service to industrial power customers has been forced upon the New England Power Company by the coal shortage combined with unfavorable water supply conditions. All such customers are required to discontinue their input of energy from the company lines for motor service by the equivalent of twenty-four hours a week.

S. C. Moore, general manager of the company, informed a representative of the ELECTRICAL WORLD in talking of conditions that dry weather during September, followed by an unsatisfactory run-off in October and early freezing of small streams on the Deerfield and Connecticut River watersheds, has been a serious handicap to the system plants. The coal shortage, which has hit many industrial plants in the territory with which reciprocal power contracts are held, has greatly curtailed the energy available by purchase. So far no lighting customers have been asked to curtail and service is being furnished to electric railways on the usual basis. Central stations, however, have been asked to investigate the use of power on their systems where such companies purchase energy from the New England organizations, so that accurate information can be compiled at headquarters in Worcester relative to the essential or non-essential character of the

demand. The company wrote to industrial power customers, pointing out the abnormal demand for energy growing out of the war and stating that a considerable portion of its output is generated now by steam. Present indications, the letter stated, are that during this winter shipments of coal into New England will be limited, for a time at least, to industries essential to prosecution of the war. On a previous occasion the company had addressed inquiries to some of its customers as to whether or not any government orders were being handled, and it therefore realizes in a general way that its power is being used in the manufacture of much war material.

The letter informed the customer that in order to present an application for priority in coal shipments, should such action become necessary, detailed information is essential immediately as to the amount and scope of war work handled by consumers. A blank was inclosed covering the main items of government and war sub-contracts, amount and nature of material involved, department concerned, probable date of completion and total production, with space for additional information of priority interest. The response was very satisfactory from the industrial customers and the material is now being assembled at headquarters.

The New England Power Company operates under agreements with central stations of its territory whereby power is interchanged as economic conditions require. The largest plant with which the system is thus connected is that of the Narragansett Electric Lighting Company, Providence, R. I. Mr. Moore stated that as soon as a new 45,000-kw. steam turbine now installed in this station can be placed in service the situation will be temporarily improved in central New England, as the New England company's transmission lines between its operating center at Millbury, Mass., and Providence can then be called upon to furnish considerably more energy to the rest of the system.

Arthur B. Lisle, general manager of the Narragansett company, informs the ELECTRICAL WORLD that every possible effort is being made to get this machine into service, but that railroad embargoes are delaying shipment of piping which is essential to operation. Arrangements are being made to transport sections of piping from New Jersey to Providence by motor truck if necessary to withdraw the equipment from the rails. It is expected that at least two weeks will be required to prepare the unit for full-load operation after fittings are installed. The Narragansett company has a fair supply of coal on hand at the moment, but, like other New England utilities, is much worried over the prospect of securing fuel for coming demands.

Temporary improvement is noted in the New England coal situation as we go to press, about 70,000 tons having arrived at Boston by water since Friday of last week. The efforts made at Washington by Governor McCall of Massachusetts and New England Fuel Administrator James J. Storrow of Boston have resulted in substantial relief from the threatened tie-up. Railroad coal movement has been expedited and cross-hauling cut down. Favorable weather has supplied reservoirs of hydroelectric power companies with sufficient run-off water from streams hitherto frozen to enable at least one company to restore full service. The Boston Edison Company, the Bay State Street Railway and the Boston Elevated Railway have received coal shipments by water this week. Power users are showing a disposition to co-operate in economical utilization of energy. A notable meeting at Springfield, Mass., a few evenings since is leading to close study of possibilities in peak load reduction on both the Springfield Street Railway and the United Electric Light Company systems, through spreading out factory and store closing hours.

RATE SUSPENSION POWER IS DEFENDED IN MASSACHUSETTS

Public Good-Will Cannot Result from Forced Increases Without Utmost Endeavors to Make Justice of Increases Clear

Suspension of a proposed rate increase until the public utility has convinced the regulating tribunal of its necessity was vigorously defended by Chairman F. J. Macleod of the Massachusetts Public Service Commission at a hearing in Boston recently. An important suggestion of Massachusetts electric railways is that the commission shall be deprived of the power to suspend rate changes pending investigation in which the burden of proof is upon the company, and that instead the companies shall have full power to make such changes as they see fit and carry them into effect at once, subject only to future commission revision based on limited jurisdiction, after investigation in which the burden of proof shall be upon the complainants.

Chairman Macleod pointed out that one fundamental weakness of this plan rests upon the questionable assumption that a sure cure for all evils of the electric railway situation lies in rate increase. The law conferring upon the commission power to suspend rates was enacted not before but after experience with the system which it is desired to reinstate. The suspension power now exists in at least twenty-one State commissions, including the Massachusetts Gas and Electric Light Commission. The steam railroads have asked Congress that the suspension power be confined to a period of sixty days from the date rates are filed.

If suspension power in commission rate cases were withdrawn, Mr. Macleod said, proceedings would be greatly protracted. In suspension cases counsel for utilities are astonishingly expeditious. They waste no words, present evidence largely in documentary form, and seldom indulge in cross-examination. If the policy were reversed, counsel would become garrulous, cross-examination would be prolonged, and of direct and rebuttal evidence there would be no end. Without overstepping bounds of legal propriety, skilled attorneys could extend proceedings almost interminably.

The commission, after investigation, might find itself powerless to reduce specific rates found excessive, because the entire rate schedule might be yielding less than a reasonable return. Mr. Macleod said that it is an unwarranted assumption to infer that a public utility must actually fail to earn a reasonable return before it can hope to be permitted to increase rates. The question of financial needs is not the only one usually at issue, the chief difficulty in many cases being to determine whether the burden is fairly apportioned among various localities and classes. Public good-will cannot result from forced increases unaccompanied by utmost endeavors to make the justice of such increases clear.

NEW ENGLAND COMPANIES MEET IN WAR CONFERENCE

Coal Shortage and Other Pressing Problems Discussed in Boston—Try to Decide on Essential Service, Is Advice Given

A war conference of the New England Section of the N. E. L. A. was held at the Engineers' Club, Boston, on Dec. 18, at which coal shortage and other pressing problems were discussed. Prior to the discussion J. F. Zoller, tax expert of the General Electric Company, spoke on the income tax law.

The serious fuel situation in New England was reviewed briefly, and the general opinion was that curtailment of service to non-essential industries must be given consideration, along with the fullest co-operation with the federal government in enforcing "lightless nights."

Even the largest water-power system in the Northeast, that of the New England Power Company, has been obliged to ask industrial power customers to curtail service the equivalent of one working day a week. Line extension work has virtually been stopped short in New England central stations.

R. W. Rollins, president Worcester (Mass.) Electric Light Company, said that power customers do not relish the prospect of curtailment and favor reduction in service to stores.

Eugene Carpenter said that by shutting down at midnight one small station on Cape Cod had saved 35 per cent of its coal consumption, the former service being from dusk to daylight. To burn wood would have cost more than the company's total revenue in this case. Flat-rate bills are discounted on account of the service curtailment.

H. T. Sands of C. H. Tenney & Company, Boston, said that his organization would not be justified in taking on additional power business without assurance by the federal authorities of adequate fuel supply. Curtailment will probably come to customers by classes. The Cambridge Electric Light Company has just refused a 200-hp. organ factory contract as non-essential. Mr. Rollins said that if power customers in Worcester would shut down at 4 p. m. about 7000 kw. of peak would be cut off the day load, with a saving in boiler operation.

Bowen Tufts of C. D. Parker & Company, Boston, urged central stations to do their utmost to solve the problem of essential service themselves, instead of waiting for a government official to take command of local operations. Shifting and rearrangement of loads offer much at this time. R. S. Hale, Boston Edison company, said that the fixing of the $2 per ton price of coal at the mines by the government had hurt the coal situation. Had the price been $3, supply conditions would have been improved. The law of supply and demand cannot operate under price limitation by fiat.

A. B. Lisle, general manager Narragansett Electric Lighting Company, Providence, cited an unusual case where private industrial customers were given power service priority before the government. Near Providence a boiler plant for destroyers is being built, and to furnish continuous power service would have required $45,000 in additional cables on the Narragansett system. The government preferred to take off-peak power, 600 kw. being available on this basis, to paying for the new cables needed. A contract was accordingly executed on this basis, other customers in the district having the preference in demand. A general discussion of line extensions closed the meeting.

LITTLE LEFT OF HISTORIC LIGHTING PLANT AT APPLETON

Ruins of One of First Incandescent Electric Lighting Plants in the Country Still on Site of Early Venture

The illustration shows all that is left of what is thought by many to have been the first commercial incandescent electric lighting plant in the world. This picture was taken recently by H. G. D. Nutting at Appleton, Wis. It shows the steel shells of the old vertical waterwheels now broken to pieces and lying on the ground. The wood construction is what is left of the harness and support, and on the other side of the

REMNANTS OF A PIONEER ELECTRIC PLANT

little bridge are the needles holding the water back in the flume, which is still connected with the Fox River.

This plant has been mentioned by many writers and referred to by Samuel Insull in speeches and in reminiscences of early days. While it is held by some that it was the first incandescent lighting station in the world, recent researches of William E. Keily of Chicago, who has given considerable thought and time to investigating historical events in the industry, seem to indicate that this was the third Edison electric lighting station in operation.

According to the best data which Mr. Keily can obtain, the Holborn viaduct in London was started either on Jan. 12, 1882, or April 11, 1882, these two dates being fixed by separate authorities. The historic Pearl Street station in New York was started on Sept. 4, 1882. The record of the Western Edison Light Company of Chicago, which took the contract from the Appleton Edison Light Company for two K dynamos, to be operated from water power and to light 550 lamps, was dated Aug. 15, 1882. Edward T. Ames, still living in St. Joseph, Mich , was sent by the Western Edison Light Company of Chicago to install that machinery. He has stated that the Appleton station was started on Oct. 15, 1882. This makes it the first Edison electric lighting station to be driven by water power and the first Edison station in the West.

STUDY FUEL ECONOMY IN NEW YORK STATE

Empire State Gas & Electric Association, Co-operating with Public Service Commission, Outlines Ways of Saving

The executive committee of the Empire State Gas & Electric Association met in New York on Dec. 21 to consider fuel economy. Its meeting followed a letter received from Seymour Van Santvoord, chairman New York Public Service Commission, Second District, asking for suggestions. Chairman Van Santvoord issued his letter after conference with the New York State Fuel Administrator, acting in co-operation with the Federal Fuel Administrator.

In taking up the subject with the companies, Chairman Van Santvoord expressed his confidence that they are keenly alive to its importance and will be anxious to assist in every way possible.

"Appreciating fully the seriousness of any proposition which may involve diminution of service to which the public has accustomed itself as not unreasonable in quantity," he wrote, "this commission begs you, nevertheless, to give immediate consideration to the question in preparation for early discussion thereof with this department, which in the meantime will be grateful for any suggestions you may be able to submit."

Replying to the letter of Chairman Van Santvoord, the executive committee of the Empire State Association, through Charles H. B. Chapin, the secretary of the association, heartily indorses "any move which will promote economy not only in the consumption of coal in generating plants, but also in the use by the public of gas and electric service, whether such service is produced by coal, water power or other means." In part the letter of Mr. Chapin says:

While your letter mentions merely "economies in fuel consumption," we believe the subject should be broadened to include economies in use of gas and electric service as well as economies in production. Economy is the slogan of the thrift campaign now in progress throughout the country. It is to be measured not by what the individual can afford to spend, but by what the country can afford to permit the individual to spend. Similarly, it is no longer a question of how much gas or electric service a consumer can afford to use, but how much of labor and materials and money, which create the service, the country can spare for the use of such consumer.

This committee believes that the gas and electric companies of the State are alive to the situation and are ready and willing to do their share. If curtailment of service either for purposes of economy or for other reasons will help in winning the war, the service should be curtailed and we are confident that each company will cheerfully co-operate.

On account of the important relation which the fuel item bears to their total operating costs, gas and electric companies are normally operated at as high an efficiency as possible in respect to fuel consumption and therefore the substitution for many purposes of gas and electric service for coal is in itself a measure of fuel conservation.

In the thrift campaign it is being urged that the utilization of men, money and materials for purposes not essential to the conduct of the war is in effect competing with the government. We venture therefore respectfully to suggest that in addition to the subject of "fuel economies" the commission might well give some consideration to other questions, such, for example, as discouraging at this time extensions and improvements to plants and systems not immediately necessary for purposes of fuel conservation or for the promotion of the interests of the country. Similar questions into which these factors enter will occur to you.

Whether or not the above suggestions meet with favorable consideration by the commission, we will hold ourselves in readiness to co-operate and assist in any way in which it is thought our services would be useful.

A suggested program of activities to promote economy in production and use of electric and gas service, sent with the letter of the association to Chairman Van Santvoord, outlines an educational campaign. It is suggested that cards be issued by the Fuel Administration similar to those of the Food Administration, and distributed by companies with bills to consumers. These would stimulate economy in electricity and gas in the home and for industrial purposes. Literature pointing out operating economies could be prepared by the association in conference with commission engineers and sent to companies, particularly those which are small. Literature pointing out possible economies in private heating and power plants could be prepared by the Fuel Administrator in conference with engineers and distributed by the Fuel Administrator. Other suggestions by the association follow:

Curtailment of Non-Essential Uses.—

1. Priority lists to be prepared by Fuel Administrator in conference with commission and association for (a) natural gas, (b) artificial gas, (c) electricity.
2. Commission to be authorized by Fuel Administrator to allow or enforce priority when necessary.
3. Priority to be granted in accordance with such list after consultation by company with commission in each particular situation.

Interconnection of Systems.—Commission to investigate in conference with New York State Electric Railway Association and Empire State Gas and Electric Association the possible economies through the tying in of separate systems, thereby concentrating the generation of power in the most efficient plants and securing fuller benefit of developed water power.

Development of Unutilized Water Power.—Commisison to confer with others having this matter under advisement with a view to securing development wherever economically possible and preventing any useless duplication or waste in transmission and distribution.

Census of Available Surplus Power.—A census of surplus capacity in power plants and transmission systems at present available in central stations to be made by the commission's engineers in conference with the association and notification of the situation in different parts of the State sent to the War Industries Board in order that new industries may be advantageously located as relates to the power situation.

EXPORT COMBINATION BILL IS NEAR FINAL PASSAGE

Measure Now Passed by Both House and Senate and Awaiting Conference Between Committees of Congress

The so-called Webb bill, which permits combinations of American business concerns to promote foreign trade and makes inoperative certain features of the trust laws which have heretofore forbidden such combinations, is nearing its final passage. The measure has been passed by both House and Senate. Certain variations, however, in the Senate and House versions will have to be straightened out in conference. No conference between the committees of the House and Senate has been held yet, and none will be until Congress reconvenes on Jan. 3 from the Christmas recess. The measure has the support of the White House, and it is not doubted that it will be passed at an early date.

WESTERN NEW YORK PLANTS FEEL THE SHORTAGE OF COAL

Appealing to Fuel Administrator, Officials of Small Properties Say that Suspension of Operation Is Possible

Small electric light and power industries throughout western New York are facing serious coal shortage. Appealing to the Fuel Administrator of western New York, representatives of many electric plants said that they will be forced to suspend operation unless assured of sufficient coal to keep fires lighted. Owing to the serious situation, the City Council of Batavia is considering the advisability of using Niagara Falls power for street lamps. The Batavia municipal lighting plant has been closed temporarily for several weeks because of the shortage, and city authorities fear that they will not be able to operate again before next spring.

The LeRoy Hydraulic Electric Gas Company, which supplies rural sections in the vicinity of LeRoy, N. Y., with electric light and power, has applied to the town authorities for permission to construct a coal storage trestle adjoining its plant. The company says that unless it can get sufficient coal during the winter to meet demands, it will be forced to curtail electricity for street lighting.

CAMPAIGN IN CALIFORNIA OF ALL BRANCHES OF INDUSTRY

Executive Committee of Pacific Coast Section of the N. E. L. A. Approves Plan to Spend $12,000 in Educational Work

After a meeting of the executive committee of the Pacific Coast Section of the National Electric Light Association in San Francisco on Dec. 5 it was announced that plans for a general co-operative campaign had been completed and would be put into effect at once. The move has the support of organizations of manufacturers, jobbers, central stations and dealers and contractors. It contemplates general educational work and is directed particularly toward securing higher efficiency in electrical merchandising.

Plans toward this end began to take definite shape when the California Association of Electrical Contractors and Dealers put $2,000 in the bank and notified other branches of the industry that this was ready for use in a general co-operative twelve months' campaign if $10,000 more would be subscribed by the other branches, so that $12,000 would be available.

The desired total was subscribed as follows in addition to the initial $2,000: Central stations, $6,000; jobbers, $2,500; manufacturers, $1,500. These funds, averaging $1,000 monthly for 1918, will be administered by a joint committee representative of the contributing branches.

Two men are to be employed to cover different territories, each to be a manager of the work in his section. It is understood that the managers are to be accorded heartiest co-operation by all concerned. They are to work on problems of the contractor and dealer and of the central station without partiality and to direct effort first to secure more widespread use of electrical energy, electrical appliances and supplies. Endeavor will be made to secure more general and effective use of the latest and best methods of demonstrating appliances and dressing windows, as well as using advertising space and following approved trade methods.

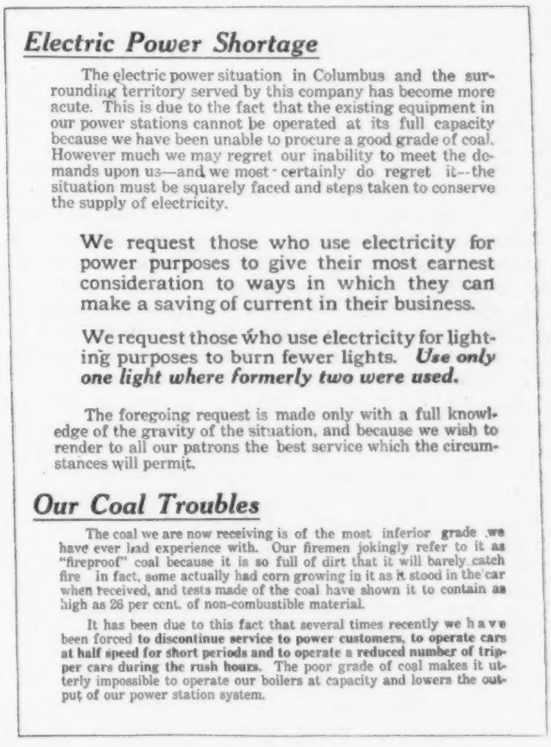
Speaking for the engineering committee of the Pacific Coast Section, J. E. Woodbridge said that the committee on inductive interference had completed its work and presented its report to the Railroad Commission and that other committees were still at work on the following subjects: A safety code for power station work; overhead-line safety code; specifications for materials for poles; insulator deterioration; iron wire for overhead lines, and standardization of pin-type insulators.

The next meeting of the Pacific Coast Section will be held simultaneously with a convention of the California Association of Electrical Contractors and Dealers at Del Monte, Cal., late in April. This will be the first occasion of simultaneous meetings, and it is looked upon as a long stride toward "an all-inclusive organization of the electrical industry."

ENCOURAGING ECONOMY IN USE OF ELECTRICITY

Columbus Railway, Power & Light Company, Urging Conservation Until New Station Adds to Supply, Acknowledges Co-operation of Public

Pending completion and operation of its new power plant, the Columbus (Ohio) Railway, Power & Light Company was obliged to ask consumers to economize in electricity. In addition to advertising, the company issued formal statements urging economy and sent representatives to impress consumers in the central district with the importance of conservation. A statement said:



Electric Power Shortage

The electric power situation in Columbus and the surrounding territory served by this company has become more acute. This is due to the fact that the existing equipment in our power stations cannot be operated at its full capacity because we have been unable to procure a good grade of coal. However much we may regret our inability to meet the demands upon us—and we most certainly do regret it—the situation must be squarely faced and steps taken to conserve the supply of electricity.

We request those who use electricity for power purposes to give their most earnest consideration to ways in which they can make a saving of current in their business.

We request those who use electricity for lighting purposes to burn fewer lights. ***Use only one light where formerly two were used.***

The foregoing request is made only with a full knowledge of the gravity of the situation, and because we wish to render to all our patrons the best service which the circumstances will permit.

Our Coal Troubles

The coal we are now receiving is of the most inferior grade we have ever had experience with. Our firemen jokingly refer to it as "fireproof" coal because it is so full of dirt that it will barely catch fire. In fact, some actually had corn growing in it as it stood in the car when received, and tests made of the coal have shown it to contain as high as 26 per cent. of non-combustible material.

It has been due to this fact that several times recently we have been forced **to discontinue service to power customers, to operate cars at half speed for short periods and to operate a reduced number of tripper cars during the rush hours.** The poor grade of coal makes it utterly impossible to operate our boilers at capacity and lowers the output of our power station system.

PART OF ADVERTISEMENT OF COLUMBUS COMPANY

The spirit of co-operation which has always been known

to exist in this community has never been more manifest than during this crisis. The Columbus Railway, Power & Light Company has followed up its recent public statements of the condition of affairs and its written requests for assistance to industrial plants and to civic organizations by placing its representatives in the business district, who are calling upon merchants and others, explaining the situation in detail and the absolute necessity for co-operation in reducing the use of electric energy if all of those using it are to secure at least a part of their requirements. They have been met everywhere by merchants with an earnest desire to assist, which is proof positive that Columbus people need only to be shown the necessity for doing a thing and they immediately set in motion the machinery for accomplishing that end.

CHANGES IN PERSONNEL OF ENGINEERING FACULTIES

Further Listing of Resignations, Leaves of Absence, Promotions and Appointments in the Electrical Teaching Body of the United States

Following is the fourth installment of the record of resignations, leaves of absence, promotions and appointments in the electrical engineering faculties of the various colleges and universities of the United States. Previous articles were published in the issues of Nov. 3, page 878, of Nov. 24, page 1022, and of Dec. 1, page 1070.

Columbia University, New York, N. Y.—Morton Arendt, assistant professor, has received a commission as a lieutenant in the navy and has been assigned to duty in connection with the submarine fleet in the construction and maintenance of the machinery of these vessels. F. W. Hehre, assistant professor, has been commissioned a lieutenant, junior grade, in the navy. He is among those recently nominated by the A. I. E. E. for the position of electrical officer in charge of the equipment on shipboard. He is now undergoing military training at Annapolis. Instructor F. L. Mason has been commissioned a lieutenant, junior grade, in the navy and is giving instruction in electrical engineering to the students of the U. S. N. gas-engine school at Columbia University, which is training the crews for the boats of the submarine patrol.

University of Kentucky, Lexington, Ky.—Minott Brooke, instructor in steam engineering, has enlisted in the merchant marine service. The position is now filled by C. C. Harp, who was graduated from the university with the degree of bachelor of mechanical engineering in the class of 1914. Since graduation Mr. Harp has been engineer of the Fayette County buildings.

University of Michigan, Ann Arbor, Mich.—Alfred H. Lovell, associate professor in electrical engineering, is now a major of engineering at Camp Custer, Battle Creek, Mich. Harry S. Sheppard, assistant professor of electrical engineering, is captain in the Signal Officers' Reserve Corps at Washington, where he is engaged in investigation work in military communication. Ward F. Davidson, instructor, is absent on leave and is first lieutenant in the Engineer Officers' Reserve Corps at Chillicothe, Ohio. The staff has been recruited by the addition of Associate Prof. Joseph H. Cannon of the Texas Agricultural and Mechanical College, with the same rank. L. H. Ballard has become an instructor, having come from the Hawthorne works of the Western Electric Company. The two staff additions are not in specific substitution for any absentee, but general additions.

University of Nebraska, Lincoln, Neb.—F. C. Holtz, instructor in electrical engineering for the last two years, is at Camp Funston, Fort Riley, Kan., where his work will be with the Signal Corps. His place at the university has been filled by the appointment of O. E. Edison, lately employed by the Commonwealth Edison Company of Chicago.

University of Oklahoma, Norman, Okla.—Prof. H. V. Bozell, director of the School of Electrical Engineering for the last six years, has resigned to accept a position as assistant professor of the Sheffield Scientific School, Yale University. L. W. W. Morrow, associate professor and acting director of the School of Electrical Engineering in the university for the last year, has been appointed director of the School of Electrical Engineering, with the title of professor of electrical engineering. Assistant Prof. Abraham Press has resigned to open an office as consulting engineer in New York City. Frank Tappan, formerly instructor at Cornell University, has been appointed associate professor of electrical engineering.

University of Pennsylvania, Philadelphia, Pa.—J. B. Straw, formerly instructor, has been advanced to the grade of assistant professor. Assistant Prof. H. M. Trueblood has resigned to accept a position with the American Telephone & Telegraph Company of New York. C. W. Plass, E. M. Bredin, F. Short and R. H. Kent, instructors, have resigned to accept positions in the government's service. G. A. Hoy was appointed instructor in electrical engineering.

University of Southern California, Los Angeles.—Prof. John Fay Wilson has accepted the position of associate professor of electrical engineering. Professor Wilson occupied for five years a similar position at the University of Michigan and during the past year at Queen's University, Kingston, Canada. He is the author of "Essentials of Electrical Engineering" and "Dynamo Laboratory Outlines."

University of Texas, Austin, Tex.—The teaching force has been reduced considerably, owing to the government School of Military Aeronautics maintained at this institution. This is now taking the entire time of Prof. J. M. Bryant, although he is still connected with this school in an advisory capacity, continuing his rank as professor of electrical engineering. J. W. Ramsay, formerly instructor in electrical engineering, has been commissioned first lieutenant in the aviation section of the Signal Officers' Reserve Corps and is devoting his entire time to instruction with the School of Military Aeronautics. W. J. Miller is the only addition to the teaching force this year. He comes as instructor in electrical engineering from the General Electric Company, Schenectady. Mr. Miller is a graduate of this school and has had several years' experience with the General Electric Company. Prof. J. A. Correll is now chairman of the school. He and Mr. Miller constitute the entire instructing force. This is made possible by the fact that peculiar local conditions, as well as the great draft of upper classmen for the national service, have reduced the enrollment, particularly in the junior and senior classes.

University of Washington, Seattle, Wash.—Associate Prof. E. A. Loew is on a year's leave of absence and is employed by the American Nitrogen Products Company as electrical engineer. No substitute has been appointed as the decrease in enrollment made this unnecessary.

University of Wisconsin, Madison, Wis.—George H. Gray, formerly instructor in electrical engineering, has accepted a position in the engineering department of the American Telephone & Telegraph Company at Omaha, Neb. Prof. R. C. Disque has been granted leave of absence and has accepted a commission as first lieutenant and been stationed with the Signal Aviation Corps of the aviation school at Chanute Field, Rantoul, Ill. Richard H. Jones, who was graduated from the electrical engineering course at the University of Wisconsin in 1915 and has since that time been with the General Electric Company, has been appointed research assistant in electrical engineering.

Virginia Military Institute, Lexington, Va.—Stewart W. Anderson, adjunct professor of physical and electrical engineering, session 1916-17, is now first lieutenant of the 307th Engineers, W. S. R. A. Willard C. Brown, assistant professor of electrical engineering, is now assistant paymaster in the navy.

Washington University, St. Louis, Mo.—Albert S. Blatterman, instructor in electrical engineering, has been granted an indefinite leave of absence in view of his appointment as first lieutenant in the Signal Corps. The commission was not received until about the first of September, and it has since been found impossible to find a substitute.

Worcester Polytechnic Institute, Worcester, Mass.—J. A. Blair and R. E. Lamb, assistants, are now lieutenants in the Coast Artillery at Fort Monroe. Their places have not been filled and probably will not be for the present.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Commission Control Over "Home Rule" Cities.—In a case affecting the city of Grand Junction the Colorado Public Utilities Commission held that it had jurisdiction over all public utilities, whether privately or municipally owned or operated, even though such municipalities are governed under a special charter known as the "home rule" amendment.

Abandonment of Unprofitable Service.—In granting an application of the Batesville Gas Company to discontinue natural-gas service in Batesville and remove its equipment the Indiana Public Service Commission says: "The rule of law is now universally accepted that when private property is devoted to public use it is subject to public regulation and control. Such property is clothed with a public interest when used in a manner to make it of public consequence and to affect an entire community, so that when one devotes property to a use in which the public has an interest he virtually grants to the public an interest in that use and submits it to public regulation and control for the common good to the extent of the interest so granted. When money is invested in the stock and bonds of public utility corporations the investors virtually loan the money to the public, and as long as the investment produces a fair return and retains the element of safety there can be no reasonable ground for complaint by the investor, while, on the other hand, if the investment fails for a number of years to pay a return and the element of safety gradually disappears, then there is just and reasonable ground for complaint being made."

Rules Governing Customers' Deposits.—On Jan. 16, 1918, the Illinois Public Utilities Commission will hold a hearing in Springfield to ascertain views of interested parties relative to "tentative rules governing the establishment of credits and the collection and handling of consumers' deposits for electric, gas, water and heating services." The experience of the commission since organization indicates that definite rules and practices, as applied to the establishment of consumers' credits and the handling of deposits made by consumers as a guarantee for prompt payment of bills, will operate to relieve considerable criticism by consumers and should also operate to protect revenues of utilities. On account of the public nature of their business, utilities are under obligation to furnish service under conditions very different from those which apply to the usual private mercantile business, and it is essential that the utility shall be assured that its consumers have an established credit in cases in which service is rendered in advance of payment. The establishment of rules and regulations should operate to prevent the exercise of unjust discrimination against consumers, and should also operate to keep unpaid or uncollectible bills within limits which may be considered as reasonable and properly to be included in normal operating expenses. Having this end in view, the commission has prepared tentative rules governing the collection and handling of consumers' deposits.

Salaries of Officers.—The proportion of operating revenues paid in salaries was taken into account by the Colorado Public Utilities Commission in a case affecting rates of the Suburban Light & Power Company at Aurora, Col. The decision says: "The commission in this case is confronted with an allowance from salaries of general officers and office clerks in the sum of $2,295 for the year Sept. 1, 1916, to Aug. 31, 1917. In other words, the salaries of officers and employees of the respondent company represent more then 50 per cent of its total operating revenues, and, in the opinion of the commission, are excessive and cannot be justified when applied to the operating revenues of this company and the value of its property in use and useful. While the commission is of the opinion that no attempt should be made to interfere with the internal management of a public utility by a regulatory body, except perhaps in rare cases, it will not approve salaries to officials which are unreasonably high and not commensurate with the duties performed. The commission recognizes efficient service and in certain cases has made allowance for efficiency, but in no case has it penalized efficient management. But in the event that this commission should take the position that the operating expenses of a public utility should not be duly scrutinized by a regulatory body in a rate-making case, then regulation would be ineffectual. The respondent, whose property in use and useful is found to be of the value of $16,000, and whose total revenues for the year Sept. 1, 1916, to Aug. 31, 1917, were $4,271, shows on its books a salary of $1,100 per annum to its president and $1,195 to its office clerks. The testimony in this case was to the effect that the president of the corporation gives practically no time to the management of this small property. The testimony shows that the son of the president manages and operates the property and that he devotes only a portion of his time to such end and receives therefor a salary of $100 per month. It is the opinion of the commission that a property of this character is really a 'one-man property' and should be managed and operated by one man at a salary not to exceed $1,000 a year." The commission held that rates were unreasonably low and did not afford a fair return to the company and that therefore a revision of the company's schedules should be made. The commission, with this consideration in view, established a new schedule to be put into operation.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Granting of Franchise by Number of Voters.—In an action by an electric light, ice and water company to enjoin a gas company from using the public streets of a town, the allegations of the complaint, showing that the matter of granting the franchise claimed by defendant was approved before granting by a majority of the qualified electors residing within the town who voted thereon at a general election at which the question of the grant was legally submitted, so that the grant of the franchise was made within the authority of the town, by law, were conclusive as to plaintiff, the Supreme Court of Arizona held, in Nogales Electric Light, Ice & Water Company versus International Gas Company (168 P. 504). The civil code cannot be construced to require a greater number of votes on the proposition of the grant of a franchise by a municipality to authorize its grant than is required by law, provided that no municipal corporation shall ever grant a franchise without the approval of a majority of the qualified electors residing within its corporate limits who shall vote thereon at a general or special election.

Powers of Commission in Rate Case.—The powers of the Public Utilities Commission are conferred by statute, and it possesses no authority other than that thus vested in it, according to the Supreme Court of Ohio (117 N. E. 381). The commission is not authorized by statute summarily to fix a rate to be charged consumers of natural gas subsequent to the expiration of a contract between the public utility and the municipality served during the period within which the operation of a new ordinance prescribing such rate is suspended by reason of the filing of a referendum petition. In the absence of an effective ordinance prescribing rates for service by a public utility, such rates should be established in accordance with the provisions of the general code. The filing of a referendum petition under the code, thereby suspending operation of an ordinance fixing price of gas after expiration of contract therefor and thus leaving no fixed rate in operation, did not constitute an "emergency" within the code provision which authorizes the commission in case of emergency to alter, amend or, with consent of the public utility concerned, suspend any existing rates, schedules or orders relating to it. An agreement as to a proper schedule of rates must therefore be arrived at in the first instance without the assistance of the commission in such circumstances as those under judicial review.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month on the next-to-last text page.

The Electrical League of Cleveland.—A. H. Gilbert addressed the Electrical League of Cleveland on Dec. 13 on the subject of "Electricity as a Factor in the Development of Brazil."

Alabama Contractors to Meet. — The Alabama State Association of Electrical Contractors will hold its annual meeting in Birmingham on Jan. 15 and 16. Col. Robley S. Stearnes of New Orleans will preside.

Philadelphia Section of Illuminating Engineering Society.—"Color Science in Illumination" was the subject discussed by Miss Beatrice Irwin at a meeting of the Philadelphia Section of the Illuminating Engineering Society held Dec. 21.

Schenectady Section, A. I. E. E.—S. T. Dodd of the railway and traction engineering department of the General Electric Company addressed a meeting of the Schenectady Section of the American Institute of Electrical Engineers Dec. 21 on the subject of "High-Speed Electric Locomotives."

Electrically Operated Bridges.—The Philadelphia Section of the Association of Iron and Steel Electrical Engineers will hold its next meeting Jan. 5. A paper will be presented on "Electrically Operated Bridges" by J. C. Reed and Merwyn J. Hocker, electrical engineers of the Bethlehem Steel Company, Steelton, Pa.

Annual Meeting of the Florida Engineering Society to Be Held Jan. 7.—The Florida Engineering Society will hold its annual meeting on Jan. 7 at Jacksonville at the Seminole Hotel. The chairman of the local committee on arrangements is C. S. Hammatt, 20 Ocean Street, Jacksonville. J. R. Benton, Gainesville, Fla., is the secretary of this society.

Milwaukee Jovian League.—The Milwaukee Jovian League held a rejuvenation and banquet on Dec. 14. Lieut. William Masson, connected with the British recruiting force in this country, described life in the trenches, from which he has just returned. There were other speakers, most of them regular members of the society who are now in the government's service.

December Meeting of the New York Electrical League.—The New York Electrical League held its monthly meeting at Stewart's on Dec. 5. James M. Wakeman, vice-president, occupied the chair. Mr. Wakeman announced that since the previous meeting of the league the board of directors had met and had applied to the Jovian Order headquarters at St. Louis for a charter. After Frank E. Watts had explained to the meeting why this action had been taken, a motion was carried unanimously indorsing the action of the board of directors in applying for the charter. Mr. Wakeman also announced that at the board of directors' meeting the following were appointed a nominating committee: George Pells, chairman; Martin Oberlander, and Elliot Reid. George Pells was elected first tribune for New York. James Betts, chairman of the Liberty Loan committee, made a report showing that the league had purchased liberally of the second issue of Liberty bonds. The speaker of the day was Roi B. Woolley, who has recently returned from service in France with the French Field Ambulance Corps.

The Engineer After the War.—E. J. Mehren, vice-president and editorial director of the McGraw-Hill Publishing Company, speaking before the Western Society of Engineers at Chicago on Dec. 17, presented an analysis of the situation engineers may face after the war. In the past, he said, engineers have attacked analytically all problems pertaining to materials. These problems amount to say 75 per cent of the problem of production in which engineers are employed. The other 25 per cent—the human section of the problems—has been turned oved to so-called managers really less capable of solving it than the engineers. The world is now beginning to look to the engineers for a 100 per cent solution. It therefore behooves the engineer as a man of vision to look into the future and see if he can discern what conditions he will face in his problem after the war. Three factors in this problem, continued the speaker, will be shortage of labor, a great drive for export trade, and high taxes. Labor will be scarce because of the man power destroyed in war and because of the strict emigration laws which European nations will pass to keep their own people at home, as a reconstruction measure. This will mean more employment of labor-saving machinery. The stage is being set for a great export drive from this country, because, regardless of how long the war lasts, the United States will be in the best position of all nations financially. She will have great natural resources to draw from and she will have the greatest merchant marine in the world excepting England. Taxes will be high because industry will have to meet the interest and principal payments on the government debt. All these things combined produce a condition in which low costs of production—the lowest ever known—will be asked by industry. The engineer with his analytical methods and trained mind is the logical man to get these costs down. To accomplish this great work, however, it will be necessary for the engineer to recognize that his science no longer deals with material alone but that it also deals with labor—the human factor. After he has recognized the new phase in the problem he must get the facts that will aid in the solution of his problem and proceed clear-headedly, retaining always the viewpoint of the labor with which he deals.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

New Office for Massillon Company.—The Massillon (Ohio) Electric & Gas Company on moving from its old office issued a formal invitation to its customers and friends to call at the new quarters, 111 West Main Street.

Relation of Hours of Work to Output and Fatigue.—An "Analysis of British War-Time Reports on Hours of Work as Related to Output and Fatigue" has been made by the National Industrial Conference Board, of which Frederick P. Fish is chairman and Magnus W. Alexander managing director.

Columbus Reduces Street Lighting.—Mayor George J. Karb of Columbus, Ohio, has ordered that only the top lamp in the clusters of street lamps in the business district be used hereafter. This was done as a means of conserving fuel. It will reduce the city street light expense about $20,000 per year.

Rates Advanced in Kentucky.—At Falmouth, Ky., the City Council has ordered a 25 per cent advance in electric rates. The minimum charge for residence service has been increased from 50 to 75 cents a month. Some time ago the city, in order to conserve fuel, began to turn off street lights at midnight.

Henry L. Doherty Advises Against New Contract at Toledo.—In a communication to the gas and light committee of the City Council at Toledo, Ohio, Henry L. Doherty, chairman of the board of the Toledo Railways & Light Company, advised that no new contract for street lighting be made at this time. While the city is endeavoring to secure a lower rate, Mr. Doherty stated that the company would expect a higher price because of increased cost of materials and labor.

Christmas Tree Distribution. — A Christmas tree distribution of soldiers' "kits" took place at the metropolitan sales headquarters of the General Electric Company, New York, on Dec. 24. The tree, illuminated by floodlights, suitably decorated and dressed, was placed in the corridor on the twentieth floor of the Equitable Building in honor of those of the staff—the "honor roll"—that had entered any branch of the United States service, sixty-nine in all, including one woman. A number of the "boys" in uniform were present and received the "kits" in person, the others being forwarded to the various camps and naval bases. Patriotic and appropriately impressive speeches were made by T. Beran, district manager; C. E. Estabrook of the incandescent lamp department; D. P. Burley, meter specialist, and W. J. Clark, manager of the electric traction department.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

A. L. Linn, Jr., has been appointed treasurer of the United Gas & Electric Corporation and the United Gas & Electric Engineering Corporation, to succeed H. J. Pritchard, who has resigned. Mr. Linn was formerly assistant to Horace E. Andrews, president of the New York State Railways and the Mohawk Valley Company, which control the electric railways in Rochester, Syracuse, Utica and Schenectady and the gas and electric utilities in Rochester and vicinity.

Alfred Douglas Flinn, in whom the secretaryships of the United Engineering Society, the Engineering Foundation and the Engineering Council will be joined, was born in New Berlin, Pa., in 1869, and was graduated from Worcester Polytechnic Institute in 1893. In August, 1895, he became a member of the engineering staff of the Metropolitan Water Works, Boston, and he remained with that organization until 1902. He rose steadily until he became principal office assistant under

A. D. FLINN

the chief engineer, Frederic P. Stearns, in charge of designs on the Wachusett dam, Weston aqueduct and other structures coming under the authority of the Metropolitan system. During his latter years with this organization he lectured on waterworks and sewerage in Lawrence Scientific School, Harvard University. On leaving the Metropolitan Water and Sewerage Board he became managing editor of the *Engineering Record* and continued in that capacity until August, 1904, when the position of general inspector of the Croton aqueduct commissioners was offered to him. He remained in that position for about a year and upon the organization of the Board of Water Supply of the City of New York, which was established in 1905, he became department engineer in charge of the headquarters department. He continued as department engineer until August, 1914, when he was made deputy chief engineer. He has continued in that capacity until his election to the secretaryships referred to in this article. Mr. Flinn is a member of the board of direction of the American Society of Civil Engineers and chairman of its committee on library.

Lee H. Newbert, formerly in charge of sales of the Pacific Gas & Electric Company, San Francisco, Cal., has been appointed commercial manager, succeeding Stanley V. Walton, whose resignation takes effect Jan. 1. Mr. Newbert will combine the duties of his present department with those of the commercial department.

Robert E. Dillon has been promoted to succeed C. H. Parker as assistant superintendent of the generating department of the Edison Electric Illuminating Company of Boston. Mr. Dillon is a graduate of the Massachusetts Institute of Technology of the class of 1910 and has been connected with the lighting company since early in 1911.

W. J. Canada is severing his connection with the Bureau of Standards to enter the work of the American International Shipbuilding Corporation at Philadelphia. Mr. Canada was for some time electrical engineer with the insurance interests in the Rocky Mountain section of the country, being stationed at Denver. He left this work two or three years ago to become associated with the Bureau of Standards, where he was chiefly engaged in the compilation of the National Safety Code as assistant to Dr. Rosee.

Edward H. Tenney has been promoted from assistant chief engineer to chief engineer of the Union Electric Light & Power Company of St. Louis, succeeding John Hunter, who has taken charge of the New Jersey district of the government emergency ship construction. Mr. Tenney, who is thirty-six years old, was graduated from Oberlin in 1903, after which he took post-graduate work in engineering at Ohio State University, from which he was graduated as mechanical engineer in 1905. In the same year he entered the employ of the Union Electric Light & Power Company in the drafting department. The following year he was transferred to the Ashley Street station of the company in charge of installation of boilers and piping, and in 1908 he was made test engineer of the company. Three years later he had general supervision of power plant work, and in 1915, when it was decided to rebuild and increase the capacity of the Ashley Street station. Mr. Tenney was made general superintendent of the plant in responsible charge of operation and construction. In addition to his work with the lighting company, Mr. Tenney is also a lecturer for a mechanical engineering special course at Washington University. Besides, he is the author of a book entitled "Ten Methods for Steam Power Plants."

William A. Del Mar, late assistant electrical engineer to the Interborough Rapid Transit Company of New York, has resigned to become chief engineer to the Electric Cable Company and the Habirshaw Electric Cable Company, Inc. Mr. Del Mar, who is a native of San Francisco, was graduated in 1900 from the City and Guilds College of London. After completing a course in the testing department of the General Electric Company, he became associated successively with the Manhattan Railway Company, the New York Central Railroad and the Interborough Rapid Transit Company. He made a specialty of transmission and distribution work while with the New York Central Railroad, and was selected by the late H. G. Stott to design the distribution system of the new Interborough subways and to redesign those of the old subways and elevated lines. Mr. Del Mar is author of a book on wires and cables entitled "Electric Power Conductors" and of the articles on wires and

W. A. DEL MAR

cables in Pender's "Handbook." He was for several years chairman of the wire and cable committee of the Association of Railway Electrical Engineers, and in that capacity was active in the standardization of specifications for wires and cables. He is also secretary of the joint rubber insulation committee, which has prepared standard specifications and an analytical procedure for high-grade rubber insulation. He has been a member of the standards committee of the American Institute of Electrical Engineers since 1913, and has taken an active part in its work, especially in matters relating to railroad standards and wires and cables. He is chairman of both the sub-committee on railway standards and the sub-committee on wires and cables. In the latter capacity he is assisting the Navy Department in the design of cables for the new electrically driven warships. Mr. Del Mar is also a member of the board of directors of the American Institute of Electrical Engineers. In his new position he will have charge of engineering work and will establish a research laboratory for investigating problems relating to wires, cables and insulating materials.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

INCANDESCENT LAMP INCREASE ANNOUNCED

New Prices on These Goods Which Are to Go Into Effect Jan. 1, 1918, Show Advances in the Neighborhood of 10 per Cent

On Wednesday a new price list on Mazda and graphitized-filament incandescent lamps, dated Dec. 22 and effective Jan. 1, 1918, was announced, bearing, as was predicted here several months ago, an increase generally around 10 per cent. With the exception of the standard 60-watt size, Schedule 6, gas-filled lamps, and Schedule 7, large-size gas-filled lamps, all list prices were advanced. The 60-watt standard size, however, was reduced in price from 36 cents to 35 cents per lamp. Prices in Schedule 6 and Schedule 7, large sizes, remained unchanged. A complete list of the new prices will be given in the next issue of the Electrical World.

Miniature lamps, with the exception of all gas-filled types and certain of the vacuum types in Schedules 4 and 5, which remained unchanged in price, advanced in price at the same time. The new discounts on miniature lamps to purchasers without contracts are 25 per cent for unit packages (the same as last year) and 40 per cent on ten or more unit packages, which is 5 per cent more than was previously allowed. To contract purchasers the discounts range from 42 per cent to 56 per cent on unit-package purchases in amounts over $500, but on broken packages in amounts over $500 list 32 per cent to 46 per cent. Under $500 list the non-contract consumer discounts will prevail.

THE CONDITION OF COPPER WIRE SUPPLY AND DEMAND

Anticipated That the New Government Price on Copper Will Not Be Found to Affect the Price of Wire

Following the conference of the Board of War Industries with the producers of copper Dec. 14, it was surmised that a change in the price established several months ago might follow. As yet no change has occurred, and there is a division of opinion among authorities on the subject whether a revision will be made Jan. 1. One of the best informed experts is of the opinion that if a new price is announced it will be a higher one. Should this be so it will not affect the market on wire. Base remains at 32 cents to 34 cents. There is a large demand for armored cable on order of the government for the submarines, and therefore it can only be promptly and efficiently met by the manufacturers direct.

Code wire used in building construction, which is almost negligible, is also selling heavily for governmental work. Hard-drawn wire for leading-in wire and copper-clad for telephone and regular signal wire are being called for. Copper-clad is being used more than hard-drawn. Underground cable, made of oiled cambric and lead-covered—power cables and feeders—is also in special demand, with heavy sales reported.

Deliveries are spoken of as fairly satisfactory, code going out of stock in large quantities. On steel-tape cable shipments can be made in from six to eight weeks, provided that the steel can be had. No positive promises can be made on these goods, delays being occasioned by the quantity and size designated. Primary hands are under the impression that not much wire is in the jobbers' stocks or with the distributing houses. It is believed that the copper situation is not so trying as it threatened to be a few weeks back. One jobber said that wire had loosened up and dropped a few points in price, and that deliveries were reaching almost a normal condition.

JOBBER LIQUIDATION OF SPECULATIVE STOCK

Tendency Decried by Trade Generally on Ground That Demand Relative to Supply Will Take Care of Any Stock Surplus

While, generally speaking, the stock in jobbers' hands of electrical supplies, with of course some exceptions, is down to normal or below normal, it is known that certain houses that speculated heavily for future deliveries when prices were lower have now unusually large stocks of certain products. In certain commodities, such as armored cable and sockets, there is now a plentiful supply to be had on almost every hand. In wire, conduit, porcelain and some other commodities, however, the case is exactly the reverse and stocks generally are pretty low.

There has been a tendency for many of the jobbers who have been so fortunate as to accumulate an overstock in these supplies to misunderstand the favorableness of their position, to the extent of underselling the current market, thereby liquidating their stock as fast as they could. With the conditions of supply and demand as they are to-day, and with a shortage so acute in most electrical staples, the practice of underselling the market is naturally being severely condemned by the more progressive and reliable members of the trade. The demand in relation to supply is sufficient to reduce this overstock in a short time. For that reason it is being urged by leading manufacturers and jobbers that those having large stocks hold them for current prices and do not release them at anything lower.

MANUFACTURERS WORKING CLOSER TO GOVERNMENT

Possibility Exists, Should Volume of Orders Greatly Increase, of Allocating Work According to Factory Conditions

By working closer to the government through the electrical division of the War Industries Board the electrical manufacturers have been better able to know the government's needs and to take care of them. At present the manufacturers will receive lists of government requirements daily. However, should the demand become large in volume, it is contemplated that weekly allocations of orders shall be made.

Similar action was taken earlier in the year on a number of electrical supplies by manufacturers' committees. The results accomplished were much more satisfactory to the government and to the manufacturers than the previous method of awarding government contracts. Now there is a possibility of extending this plan to the entire industry. Through this procedure the government can obtain its requirements in the minimum time and at the minimum cost. Furthermore, no manufacturer is unduly loaded up with government work.

To buyers other than the government the results are desirable, for deliveries, while longer perhaps throughout the entire field, are nevertheless surer.

The demand for electrical goods for war purposes is increasing. Still, there appears to be an electrical manufacturing capacity in excess of direct government needs. Manufacturers are being asked by the War Industries Board whether the indirect demands from secondary sources will absorb the available capacity.

NEW COMPETITION AMONG THE FUSE MANUFACTURERS

Standard Producers to Place Refillable Types on Market in the Near Future, Probably During the Coming Week

The revelations of the last two weeks have brought to a head the intention of manufacturers of standard or non-refillable fuses to put on the market types of refillable fuses also which have been in the process of development for some time. The Chicago Fuse Company, one of the manufacturers of the standard line, expects to put a line of the refillable fuses on the market in a day or two. Last week the Economy organization gave notice to the trade that it had purchased the Detroit fuse, one of the well-known standard types.

While the other fuse manufacturers have not as yet disclosed their program, so far as could be learned on inquiry all makers of the one-time type of fuse expect to bring out shortly, probably by the first of the year, a renewable or refillable type. In fact, reports say, they had been working along these lines when the foregoing sale came along. Just what the selling policies of the various companies interested may be is not yet definitely known. It is believed, however, that prices and sales activities will remain undisturbed, for the present at least. The presumption is that with a greater number of both types in the market a greatly increased production will follow. Under the stress of competition this may lead to a revision of prices downward. In the meantime considerable jockeying is said to be going on between the fuse concerns to ascertain what schedule will be adopted by other manufacturers.

METAL MARKET SITUATION

Resale of Copper to Manufacturing Consumers Proceeding Easily—Tin Is Scarce and High

Copper is in a much easier and more favorable position now than for three years past. The resale of the metal is progressing in a manner to satisfy the authorized distributers, dealers and legitimate commercial consumers. In addition to the 5 per cent allowed above the official price to cover the expenses of handling and profit, freight may be added to point of destination and a charge of $2.50 for 1250 lb. may be made when ingots are shipped that must be packed to conform to transportation rules. Terms are net cash at time of shipment, or interest at 6 per cent if credit is extended.

The changes in the other metals, with tin partly out of the market, as none is offering, are only a point or two.

NEW YORK METAL MARKET PRICES

	Dec. 17	Dec. 24
Copper:	£ s d	£ s d
London, standard spot	110 0 0	110 0 0
Prime Lake	Govt. price 23.50	Govt. price 23.50
Electrolytic	Govt. price 23.50	Govt. price 23.50
Casting	Govt. price 23.50	Govt. price 23.50
Wire base	27.00 to 29.00*	27.00
Lead, trust price	6.25	6.25
Nickel, ingot	50.00	50.00
Sheet zinc, f.o.b. smelter	19.00	19.00
Spelter, spot	7.67½	7.67½
Tin, Straits	80.00†	85.00†
Aluminum, 98 to 99 per cent.	34.00 to 36.00	34.00 to 36.00
OLD METALS		
Heavy copper and wire	22.00 to 22.50	22.00 to 22.50
Brass, heavy	14.00 to 15.00	14.00 to 15.00
Brass, light	9.50 to 10.50	9.50 to 10.50
Lead, heavy	5.75 to 5.87½	5.75 to 5.87½
Zinc, old scrap	5.00 to 5.50	5.00 to 5.50

*Nominal. †None offering.

THE WEEK IN TRADE

GRATIFYING reports are proof of a generally excellent selling season for the holiday week throughout the country. Household specialties and novelties were in strong demand, owing in great measure to the spirited publicity campaign carried on by the manufacturers and followed up by jobbers and dealers in local application. A few spots were weak on these goods, but they were the exception and not the rule. The outlook on staple lines for the coming year is bright, with the distributing houses ordering adequate stocks of fans, fuses, dry batteries, sockets, conduit, wire, etc., with a view of as early deliveries as conditions will allow. Shipments delayed by freight congestion are not going forward in an altogether satisfactory manner, and the immediate prospect of an improvement is not apparent.

The financial situation is not complained of by either manufacturers, jobbers or dealers. Collections and credits are reported as well in hand.

NEW YORK

Few jobbing houses have reason to complain of business during the year-end week. With few exceptions, and among them certain holiday specialties, electrical goods have not sold up to expectations, but the average was nevertheless quite high, all things being taken into consideration.

Outside of nearby points deliveries are growing more acute. Western shipments are in better shape than goods coming East, though jobbers and dealers have been fairly well taken care of. Cases are reported where bonuses have expedited the prompt delivery of merchandise.

Collections are described as quite up to the mark. Credits are carefully looked after with commensurate results.

TRANSFORMERS AND GENERATORS.—The delivery of transformers and generators of medium size is improving. An order for transformers recently placed is promised for April, 1918, delivery if government priority orders do not intervene. In that event shipment will be postponed indefinitely.

COLLECTIONS AND CREDITS.—Credit departments of the principal jobbing firms report collections as in a good position. Dealers are meeting their paper promptly, as business is excellent. Credits, while carefully scrutinized, are along satisfactory lines.

GEARS AND PINIONS.—Quotations on gears and pinions are being made in a gingerly manner by producers and suppliers. The market is rather unsettled, and on a recent proposal for bids not one had been received from the manufacturers after an interval of two weeks. No contract would be accepted or delivery promised.

FANS.—The new fan contracts for 1918 are about ready to go out, in some instances have already reached the jobbing houses and distributers. The increases in prices, announced exclusively in a recent issue of the ELECTRICAL WORLD, are not deterring the buyers.

HOLIDAY SPECIALTIES.—It was expected that a heavy business on holiday specialties would be realized, and with a number of jobbers and dealers this is so. An unexpected falling off in certain localities has occurred, however, and considerable stock will be carried over.

CONDUIT.—According to several jobbers, who may have been cramped for a sufficient quantity of conduit, it is now in an easier position, with satisfactory deliveries.

LAMPS.—The situation has bettered. On some sizes there is yet a shortage. Other types are reported to be plentiful.

DRY BATTERIES.—The sale of dry batteries for a week or two was active. Prices are slightly unsettled, but no advances are reported.

FUSES.—Heavy stocks of fuses are being carried by New York jobbers, some totaling $8,000 to $10,000. Manufacturers are said to have had an excellent year and look forward to a better one in 1918.

CHICAGO

Last-minute reports from the retail trade in the Central Western territory seem to indicate that Christmas shopping in electrical goods for 1917 is just about equal to what it was last year. In some quarters the comment is heard that the trade is somewhat lighter, but when it is remembered that 1916 was a banner year this can perhaps be explained easily. Staple and semi-luxury goods were among the best sellers.

While engaged in its Christmas retail sales the trade is also viewing the approach of 1918. Although it is admittedly dangerous to prophesy, the opinion is volunteered that business next year will continue at practically its present volume and prices for at least some months. Central stations are, of course, known to be reducing expenditures, but it is certain that more than 50 per cent of the normal capital requirements of some large plants must of necessity be spent. In addition to this, the industrial outlook is very bright, which seems to indicate that not only will factory supplies move readily but also that industrial workers will have money with which to fill domestic needs.

CHRISTMAS TREE OUTFITS.—In accordance with custom nearly every one who had any stock of Christmas tree outfits reduced prices for the week just before Christmas. This practice never, as far as can be observed, has influenced sales, yet it is followed annually by practically the entire trade.

PORTABLE LAMPS.—This is one item which is enjoying ready sale in spite of the fact that it might be construed to be in the luxury class. The fact that it also has a practical and utilitarian value seems to have made it a popular compromise between the usual type of gift and the necessity.

MOTOR-DRIVEN SEWING MACHINES. — Retail trade on these devices is showing marked increase.

HEATING APPLIANCES.—Sales in some quarters are reported not up to expectation.

CONDUIT.—Prices remain the same, and in some quarters deliveries are getting worse.

COPPER WIRE.—Wire is still on a 34-cent base with not a great deal of activity in the field.

WASHING MACHINES.—The demand continues to exceed the supply even with all factories operating at top speed.

GLASS INSULATORS.—Since the recent price increase there has been little activity, and none is expected, since the majority of these goods are now purchased by railroads.

ELECTRIC RANGES.—Orders for two carloads were received by a Chicago factory this week. One was for immediate shipment and one for shipment in the middle of March.

BOSTON

While this year's Christmas trade appears to be running somewhat behind that of 1916, the total volume of sales is large, and the last few days of Christmas week showed rapid gain in the rate of turnover. Jobbers report a healthy demand for electrical conveniences, especially of the labor-saving kind. Electrical outfits for Christmas tree use have been moving exceptionally well, and a fine business has been done by many concerns, wholesale and retail, in portable lamps. Stocks of small motors up to 25-hp. rating are increasing. Owing to coal scarcity, many central stations are letting their appliance business run along largely of its own momentum, though other companies are vigorously pushing the lighter equipment of relatively low energy consumption. Deliveries are getting poorer, chiefly on account of railroad congestion. Collections are reported slower. As before, government demand occupies the forefront, and much more electrical material remains to be purchased for the Squantum destroyer plant and other war installations.

Jobbers' stocks are fairly large. The lamp situation is much improved compared with last year in the larger sizes, and the outlook is for continued heavy business in at least the early part of 1918. Money is high, and is being accumulated in many quarters for the next government bond issue.

DELCO LIGHTING SETS.—Twelve hundred of these have been sold in New England in the last fourteen months, the standard rating being 0.75 kw. A price advance from $420 to $465 takes place Jan. 24. Bad roads in the rural districts handicap winter sales somewhat, but the use of kerosene in these units has helped the coal situation this fall without question.

FLASHLIGHTS.—Standard lines are moving well, but novelties are going slower. The military and naval market is excellent, especially for Christmas giving.

SECOND-HAND EQUIPMENT.—Business is quieter, the lull being due to the withholding of orders as the year closes. One dealer reports a stock of 600 electric motors, including some units of 50-hp. to 150-hp. rating. Generators are in fair supply and a few boilers are available.

RADIATORS. — Trade is well maintained. Prices hold firm and stocks are in good shape despite the early winter.

MOTORS.—Stocks are increasing in units up to 25 hp. Manufacturers have been concentrating upon the production of smaller sizes, with good results. Much attention is being given to improved driving conditions, and readjustments in many hastily equipped plants are in order to increase production and incidentally to save power and fuel per unit of output. Prices are still holding steady.

WIRE AND CABLE.—Stocks of the smaller sizes are fairly good, but larger sizes are difficult to obtain without priority orders. Shipments are about the same as hitherto. An 18,000-lb. order of weatherproof for government use was brought into New England by express a few days since. Commercial orders are hard to execute in the face of government calls. Rubber-covered quoted firm at 33 cents and weatherproof at 29 cents. Jobbers are not stocking much large wire.

CONDUIT.—A shortage is reported in the larger sizes, with substantial local stocks of ½-in. and ¾-in. The demand for the former is heavy. Prices are somewhat disturbed by the practice of some brokers in quoting new business on the basis of undelivered shipments at lower figures than now prevail. The non-maintenance of stocks by manufacturers' agents who do a brokerage business by handling less-than-carload orders on the basis of carload quotations is receiving some criticism as a policy.

ATLANTA

Business emanating from government sources indicates a slight slowing up, due, no doubt, to the holiday season.

The overshadowing feature in trade this week is the large volume of business being done in specialties. Jobbers and dealers state that more electrical appliances are being purchased for gift purposes this year than ever before. The recent cold spell has further stimulated the sale of heaters of all descriptions. Irons, percolators, grills, portables and shaving mugs are moving rapidly, and it is expected that the inventoried value of such articles carried over to 1918 will show a big decrease over other years.

Manufacturers report that the volume of general supply orders during the last week has been holding up fairly well, but while the aggregate is comparatively large the individual orders show a marked decrease in amount per order. This condition is expected, however, during the pre-inventory period. Reports from the various manufacturers indicate that collections are excellent and slightly better than November. This is accounted for by the fact that the manufacturers are exerting extra effort before the close of the calendar year and that large amounts have been borrowed on short-term notes to provide the necessary capital for raw materials which had to be purchased to cover the present abnormal demand.

FANS. — Manufacturers have about completed making 1918 fan contracts with jobbers and dealers. Substantial orders are being placed and delivery quotas are slightly in excess of 1917, anticipating better fan weather in 1918.

HEATING PADS.—The demand for these in the last week has been away above normal, and local stocks are getting low. The jobbers state that the increased business emanates from outlying small central stations.

ANNUNCIATORS.—Business in this line is good and price cuts little figure with the type of industries demanding this class of goods. Prices average from 20 to 40 per cent upon standard equipment and 100 per cent advance over last year on specials.

CROSS-ARMS.—The decreasing demand on government construction has caused a slump in sales, and local stocks are beginning to accumulate. Prices have remained unchanged for the past sixty days.

CARBON LAMPS.—Renewed activity is noted in the call for 16-cp. equivalents from certain quarters owing to inability of dealers to deliver the 25-watt and 40-watt tungsten lamps quickly.

BELL-RINGING TRANSFORMERS.—The increasing cost of dry cells together with uncertain deliveries has tended to swing a large portion of this type of business to transformers. Sales up to date show an increase of approximately 80 per cent over 1916. Prices remain steady, shipments are good, and prompt deliveries are being made.

SAFETY LOCK BOXES.—Ordinances passed in Atlanta and Jacksonville recently requiring duplex and other types of apartments to use the combination switches in safety boxes has stimulated this line, and a substantial business is being transacted. Deliveries have been fairly prompt and local stocks are in good shape.

CONDUIT.—Conditions in delivery seem to be growing steadily worse, and jobbers state that no definite promises of shipment can be secured from any source. Prices remain firm.

SEATTLE

The week of Dec. 17 to 24 was featured along electrical lines by enormous sales of holiday merchandise, particularly toaster stoves, flatirons, percolators, warming pads, vacuum cleaners and table lamps. The volume of sales of electric washing and sewing machines increased over the last two weeks. Retailers who have been conducting a heavy advertising campaign during the last three weeks report that Christmas sales of electrical goods have never before been equaled. The predicted eleventh-hour rush for electrical presents began Dec. 21 and increased until closing hours Saturday. Electrical dealers state that the increase in business as compared with the 1916 season is from 40 to 60 per cent. While movement of novelty goods is better than last year, the percentage is not so high as compared with the sales of better-grade electrical merchandise.

Sales of staples to shipyards and industrial plants in Portland during the week showed noticeable increase due to the award of several contracts for wooden and steel vessels. Wholesalers in the Northwest are busy with the invoice period, and retailers as well as wholesalers are beginning to stock heavily, fearing the expected order from Washington eliminating non-essentials. Northwest dealers are becoming converted to the belief that the war will extend over a long period and are trying to prepare for this contingency.

Plans for the immediate establishment of another large wooden-shipbuilding plant in Seattle were announced during the week. This is the third project of this kind reported recently. There are thirty-four plants engaged in wooden-ship construction in Washington, and approximately one-third are constructing vessels for the United States Shipping Board. Wooden and steel shipbuilders of Seattle, Tacoma and vicinity have jointly notified the Shipping Board that they will guarantee to launch and finish 600,000 dead-weight tons of steel ships and 400,000 tons of wooden ships during 1918.

Reports from Spokane state that building is on the increase and that permits for the last month were 500 per cent greater than for the same period last year. Building at Tacoma is also on the increase owing to the proximity of American Lake Cantonment and new shipyards there. Homes under construction are of good type and contain all modern equipment. Tacoma and Spokane electrical retailers report increased sales of fixtures and other equipment for new building. The Seattle Chamber of Commerce and Commercial Club is preparing to solve the problem of housing from 15,000 to 20,000 men who are to be sent here by the government to work in the shipyards at an early date.

As a means of speeding production of spruce for airplane building the government has announced a substantial bonus on all deliveries prior to Feb. 28, also a new and higher price per 1000 ft. It is stated that spruce production has so far amounted to only 40 per cent of government requirements.

The freight situation in the Northwest is becoming more aggravated daily. During last week Seattle was almost cut off from Eastern train service by floods and washouts of bridges and tracks, thereby increasing freight congestion. Collections are up to market. Credit men are endeavoring to close the business with as good showing as possible.

SAN FRANCISCO

The freight-car embargo and general freight congestion have heretofore affected the San Francisco electrical field chiefly in the time advisable to allow for advance orders, but actual delays in delivery are now complained of and an immediate effect on the market has resulted. The general feeling is that transportation conditions are certain to get worse before they improve, and with factory conditions remaining the same the prospects as to stock and deliveries are declining. However, there continues to be a brisk demand in many lines and salesmen are being coached in keeping customers content with the best available terms of delivery or with partly filled orders.

A feature of the San Francisco situation this week uppermost in the construction field is the proposed strike of iron workers, about 10,000 of whom are reported to have decided to walk out unless their demands are granted. This strike order would include certain classes of electricians and would indirectly affect others by temporarily closing down work. Christmas trade as a whole was reported by the jobbers to have been somewhat below expectation, although in some few lines it was well above average. For example, enormous quantities of pocket flashlights were sold. The buying was generally for staple articles. Conservation seemed to be the keynote among Christmas shoppers this year. In some quarters there is a rather depressed view of January prospects, but it is being pointed out that with a conservative market the reaction after the holidays will be less than usual, and it is notable that collections are invariably better in January than in December.

CREDITS AND COLLECTIONS.—Little change in the financial situation occurred this month. Manufacturers' agents who deal largely with firms enjoying excellent credit report good conditions, and the jobbers who have for months practiced a conservative policy state that while caution is advisable there is no complaint about the present situation.

SMALL MOTORS.—Meager stocks in sizes up to 10 hp. are available. One manufacturer is quoting three to four months' delivery on sizes under 50 hp. and seven to eight months on larger units. Many orders are coming in for motors to be brought to San Francisco and held for shipping instructions pending the delivery of the machinery which the motors are to drive.

ELECTRIC SIGNS.—Although no coal is used for generating electricity in San Francisco territory, there has been some doubt about the application of the Fuel Administrator's orders on sign lighting, and this has seriously crippled the sign business. One co-operative sign campaign was canceled by the power company and business has fallen off practically 50 per cent in many quarters.

STORAGE BATTERIES.—Automobiles are used all the year round in California. This is cited as the cause of a demand for batteries in San Francisco that continues increasing after the Eastern peak has passed. One firm now has en route to San Francisco three carloads of battery parts and materials for assembly there, as well as two carloads of made-up batteries, furnished by the Eastern plant to supply the San Francisco demand until that branch can catch up.

WIRELESS APPARATUS.—Although the general rule on all vessels taken over by the United States Shipping Board is that the navy standard radio sets are to be installed, it has not been found advisable to adhere absolutely to this rule. In fact, one firm in San Francisco has recently closed contracts for installing radio sets on a number of vessels now under the jurisdiction of the Shipping Board. The report of German raiders in the Pacific has also notably increased the demand for radio sets for privately owned vessels too small to be included under the jurisdiction of the United States Shipping Board.

Current Prices of Electrical Supplies

NEW YORK AND CHICAGO QUOTATIONS

The prices quoted are those prevailing in standard packages or specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the source of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers.

The variation in prices may be due to the difference in grade of products made by different manufacturers, to local conditions, or to both.

ARMORED CONDUCTORS, FLEXIBLE STEEL

Single-Conductor

B.&S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid

Less than coil.....List to $61.00
Coil to 1000 ft.....5% to $59.17

No. 12 Solid

Less than coil.....List to $71.00
Coil to 1000 ft.....5% to $68.87

Twin-Conductor

No. 14 Solid

Less than coil.....List net to $105.00
Coil to 1000 ft.....$70.00 to 10%

No. 12 Solid

Less than coil.....List net to $135.00
Coil to 1000 ft.....10% to $130.95

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid

Less than coil.....List +10%
Coil to 1000 ft.....—10%

No. 12 Solid

Less than coil.....+10%
Coil to 1000 ft.....—10%

Twin-Conductor

No. 14 Solid

Less than coil.....+10%
Coil to 1000 ft.....—10%

No. 12 Solid

Less than coil.....+10%
Coil to 1000 ft.....—10%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.....10%
1/5 to std. pkg.....20%
Std. pkg.....34%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.....+20% to 12%
1/5 to std. pkg.....List to 20%
Std. pkg.....28% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.285	.295

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.3175	.3275
Barrel lots	.2875	.2975

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List, Per 100 Ft.
5/16	250	$5.00
⅜	250	7.50
½	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less Than Coil	Coil to 1000 Ft.
¾-in. s. stp.	$75.00	$69.75
¾-in. d. stp.	75.75	72.00
½-in. s. stp.	100.00	93.00
½-in. d. stp.	100.00	96.00

NET PER 1000 FT.—CHICAGO

	Less Than Coil	Coil to 1000 Ft.
¾-in. single strip	$75.00	$63.75
¾-in. double strip	78.75	71.25
½-in. single strip	100.00	85.00
½-in. double strip	105.00	95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List Per Foot	Size, In.	List Per Foot
7/32	$0.05½	1	$0.25
¼	.06	1¼	.33
⅜	.09	1½	.40
½	.12	1¾	.47
⅝	.15	2	.55
⅞	.18	2¼	.65

NET PER 1000 FT.—NEW YORK

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.—	$25.00-$55.00	$20.50-$24.75	$20.00-$22.00
¼-in.—	$28.00-$60.00	$20.00-$22.00	$22.00-$24.00

NET PRICE 1000 FT.—CHICAGO

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.	$55.00	$25.00-$37.50	$22.50-$24.75
¼-in.	$60.00	$27.00-$30.00	$25.00-$27.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 38

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37
2½	.58½
3	.76½

	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.50
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	4% to 6%	7% to 9 %
2500 to 5000 lb.	6% to 8%	9% to 11%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ in. to ½ in.	¾ in. to 3 in.
Less than 2500 lb.	1.3% to 3.7%	4.3% to 6.7%
2500-5000 lb.	3.3% to 5.7%	6.3% to 8.7%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price.....$5.00 to $6.00
Discount.....30%

CHICAGO

List.....$5.00 to $6.00
Discount.....30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.....28%
1/5 to std. pkg.....38%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.....28%
1/5 to std. pkg.....38%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.00 to $5.75
1/5 to std. pkg.	4.50

Standard package, 500. List, each, $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard package, 500. List, each, $0.07.

LAMPS, MAZDA

105 to 125 Volts

Regular, clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.27
60-watt—B	100	.36
100-watt—B	24	.65
75-watt—C	50	.65
100-watt—C	24	1.00
200-watt—C	24	2.00
300-watt—C	24	3.00
Round bulbs, 3½ in., frosted:		
15-watt—G 25	50	.50
25-watt—G 25	50	.50
40-watt—G 25	50	.50
Round bulbs, 3⅝ in., frosted:		
60-watt—G 30	24	.72
Round bulbs, 4⅝ in., frosted:		
100-watt—G 35	24	1.05

DISCOUNT—NEW YORK

Less than std. pkg.	Net
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	Net
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00 to $33.98
Coil to 1000 ft.	25.50 to 25.82

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00 to $36.24
Coil to 1000 ft.	22.50 to 27.18

LAMP GUARDS, WIRE

Standard packages from 50 to 150.

NEW YORK

Net per 100	$20.00 to $29.00

CHICAGO

Net per 100	$19.25

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200 S.E., 300, AX, 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S. 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	25%	20%
$10.00 to $50.00 list	42%	37%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

PORCELAIN CLEATS—UNGLAZED

2 and 3 Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$20.00 to $38.00
1/5 to std. pkg.	19.00 to 20.00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$15.80
1/5 to std. pkg.	14.80

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

Per 1000 Net	Std. Pkg. 3500 5½ N. C.	Std. Pkg. 4000 Solid Nail-it—N.C.
Less than 1/5 std. pkg.	$27.50 to $29.00	$30.75
1/5 to std. pkg.	15.60 to 20.75	24.20

CHICAGO

Per 1000 Net	Std. Pkg. 3500 5½ N.C.	Std. Pkg. 4000 Solid Nail-it—N.C.
Less than 1/5 std. pkg.	$11.85	$30.75
1/5 to std. pkg.	11.10	24.20

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	20%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	14%
1/5 to std. pkg.	20%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3. P. S. T.	1.80
60-amp. 3. P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	List net to + 5%
$10 to $25 list	11%
$25 to $50 net	14% to 15%
	Low Grade
Less than $10 list	5% to 10%
$10 to $25 list	16%
$25 to $50 list	24% to 25%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+5%
$10 to $25 list	—11%
$25 to $50 list	—14%
	Low Grade
Less than $10 list	—5%
$10 to $25 list	—16%
$25 to $50 list	24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

SWITCHES, SNAP AND FLUSH—Cont'd

10-Amp. 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	List
1/5 to std. pkg.	15%
Std. pkg.	28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+20% to list
1/5 to std. pkg.	List to —15%
Std. pkg.	List to —30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List	List
$2.00 to $10.00 list	10% to 20%	5%
$10.00 to $50.00 list	20% to 30%	15%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25%	15% to 20%
$2.00 to $10.00 list	25%	20%
$10.00 to $50.00 list	25% to 35%	20% to 25%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00
Discount	30%

CHICAGO

List price	$5.50 to $6.00
Discount	30%

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.44¼ to $0.65
No. 18, full spools	0.43¼ to 0.55

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.64 to $0.65
No. 18, full spools	0.54 to 0.55

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
11.	$15.00-$18.00	$13.00-$14.00	$11.25-$12.00
12.	23.25- 27.09	21.31- 23.22	19.35- 20.85
10.	32.40- 37.80	29.70- 32.40	27.00- 29.25
8.	45.70- 53.34	41.90- 45.73	38.00- 41.38
6.	72.40- 84.42	66.35- 72.40	60.30- 65.50

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$18.00	$13.50	$12.00
12	26.95-27.79	23.85-26.95	19.85-23.10
10	33.24-37.65	30.47-32.27	27.70-30.32
8	47.04-53.05	43.12-45.47	39.20-45.72
6	68.25-84.01	62.05-67.64	55.85-72.01

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 8 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$35.25 to $40.00
25 to 50 lb	36.25 to 39.00
50 to 100 lb	34.25 to 38.00

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$40.00 to $40.35
25 to 50 lb	39.00 to $39.35
50 to 100 lb	22.30 to 38.35

NEW APPARATUS AND APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Threaded Catch Socket

A threaded catch socket designed in such a way that it can be easily assembled and so that the shell cannot be pulled apart by many times the strain to which it will be subjected in service is now being made by the General Electric Company of Schenectady, N. Y. Lugs on the cap fit into the body of the shell, and a threaded ring holds the cap firmly in place.

This improved socket design is offered in place of ordinary types where the threaded feature mentioned is essential. This type of socket is made in key, keyless and pull designs and in locking types, key and keyless.

Porcelain Locking Socket

Pass & Seymour of Solvay, N. Y., have recently placed on the market their "Shurlok" porcelain socket. It is pointed out that the advantage of this locking socket is that it provides a practical means of locking the lamp in the socket so that it cannot be removed without the use of the master key.

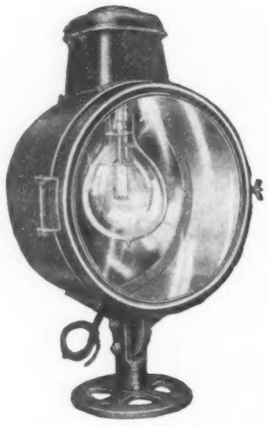
The Shurlok screw with the special head is carefully designed so that it cannot become lost or misplaced. The lamp base is carefully positioned in the socket shell by especially placed ribs or corrugations on the inside of the porcelain shell which prevent the lamp from being forced out of perfect alignment with the socket. The porcelain boss or extension is of rugged construction, and it is claimed that the socket will not be damaged by the ordinary rough usage that it is subjected to and that therefore it will have a longer life than is often the case with sockets less strongly constructed.

RESISTS CHEMICAL ACTION

The porcelain shell is not disintegrated by acids, fumes or gases. The standard porcelain socket or receptacle is composed of a body and the cap or base. When the lamp is removed the retaining screws are made accessible, and the socket must be installed before a lamp can be used. In locking the lamp in by means of "Shurlok" the shell and cap of the socket are locked so that they cannot be taken apart. A wide variety of locking sockets and receptacles are now obtainable because the porcelain "Shurlok" body is interchangeable with the complete line of porcelain caps and bases made by this company.

Flood-Lighting Unit

As a further development of its line of "Golden Glow" and "Crystal Mirror" flood-lighting projectors, the Electric Service Supplies Company has placed on the market a new flood-lighting unit to be known as type FL-1419. This new type of projector is particularly designed for short-range work where a wide beam dispersion is desired. It is equipped with 14-in. (35.6-cm.) long-focus-type parabolic



FOR SHORT-RANGE WORK

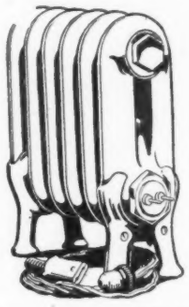
"Golden Glow" or "Crystal Mirror" reflectors, which project respectively powerful dispersed beams of rich golden light and white brilliant light.

This company in its recent catalog on flood-lighting projectors classified the different flood-lighting subjects into two divisions, namely, those in which the human eye is brought into continuous use to observe detail and those in which the human eye figures only momentarily or where lighting the subject as a whole is the main consideration. In the first classification "Golden Glow" light is strongly recommended, and in the latter class the white, brilliant light from "Crystal Mirror" projectors is desirable.

This new type meets a demand for a more powerful projector than any heretofore cataloged by this company, it being adapted to use with 500-watt to 1500-watt type C Mazda (or nitrogen-filled) lamps.

Portable Nitrogen Radiator

The Willis Manufacturing Company of Cleveland, Ohio, is offering to the trade the portable electric nitrogen radiator shown in the accompanying illustration. This radiator is said to be the only auxiliary electric heating apparatus filled with nitrogen gas which is built on scientific principles adopted by heating engineers of standing—*i. e.*, the radiator. It maintains an average temperature of 350 deg. Fahr. (176.7 deg. C.), it is said. The radiator contains an electric heating element surrounded by nitrogen gas. The gas fills the entire inside of the radiator, which is hermetically sealed. The gas serves to carry the heat from the heating element to the radiating surfaces at a temperature higher than that of a steam radiator. One feature pointed out for this device is that there is no way by which clothing, drapery or anything else can catch fire, as it has no exposed red-hot open wires. The cost of operation of this radiator is very low. The stock radiators are made in four, six, eight and ten sections. Special radiators may be built in any size or type desired.



CONTAINS HEATING ELEMENT SURROUNDED BY NITROGEN GAS

Portable Motor-Operated Bench Planer

The J. D. Wallace Company of Chicago has developed a portable motor-operated bench planer and joiner for light woodworking operations. The device and motor are a single unit with direct drive through a flexible coupling which delivers approximately 100 per cent of the power applied.

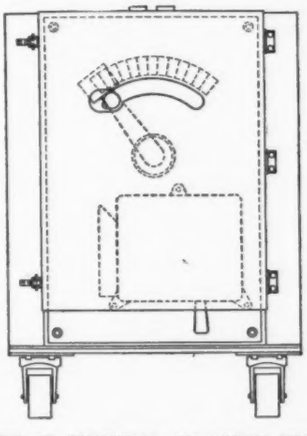
A feature of the machine is that three knives are operated on the cutter head if an alternating-current motor is used and two if a direct-current motor furnishes service. The direct-current motor makes 4000 r.p.m. and the alternating-current motor 3600 r.p.m. Fractional-horsepower motors made by the General Electric Company are used.

Portable Outlet Panels for Electric Welding Service

For an electric welding outfit to be of its maximum service it must be so arranged that it can be taken to the work no matter where that is to be performed. A recently developed portable outlet panel manufactured by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., takes care of this situation with a minimum of expense and with all the simplicity of the familiar distributing system for storage-battery charging, it is claimed.

Two types of portable outlet panels are furnished, both being mounted on light trucks. They consist of a control panel mounting a handle-trip railway-type circuit breaker having overload release with magnetic blowout and a thirteen-point face plate connected to a resistor mounted in the rear of the panel. The face of the panel is protected by a metal cover through which the handles of the rheostat and circuit breaker project. The resistor is made up of grids and is protected by a cage of expanded metal. The type E panel is intended for metal electrode welding only, having a capacity of from 80 amp. to 170 amp. With this outfit one metal electrode holder and one shield are supplied. For a wider range of work a type F panel should be used. This will handle metal electrode work from 80 amp. to 160 amp. and light graphite electrode work up to 300 amp. The outfit includes one metal electrode holder, one graphite electrode holder and one mask.

In installing an electric welding system using these portable panels the best method, the makers say, is to place a Westinghouse arc-welding motor-generator set at some central point. Where suitable low-resistance ground connection can readily be made throughout the shop, as, for instance, where metal floors or cast-iron bedplates are in general use, or in a railway shop



PANEL IS MOUNTED ON LIGHT TRUCK

where the track system can be used, only one connector need be extended to the various receptacles. The iron floor plates may be arc-welded to each other and isolated sections tied together by an iron rod or heavy copper cable, while the track rails may be bonded by arc-welding the fish plates to the rails. Receptacles should then be provided at suitable points throughout the shop of a capacity appropriate for the service for which they are intended. These receptacles may readily be mounted out of doors if they are provided with protection from the weather. Only single-pole receptacles and a single wire cable to the portable panel need be provided. This cable should be of sufficient length so that the panel may be placed as near as possible to the work in order to save steps and valuable time for the welding operator. The flexible cable leading from the panel to the electrode holder should be as short as is consistent with the class of work to be done.

Where metal floors or tracks are not available the ordinary two-wire system of distribution with double-pole outlets and two-wire cables should be provided.

Snap Attachment Plug

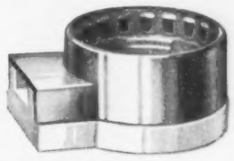
One of the latest electrical products of the Sales Development Company of 299 Madison Avenue, New York City, is an attachment plug that snaps into the ordinary Edison socket with a slight pressure of the finger. A sleeve contact is made through a bronze spring

NO TWISTING OF WIRES RESULTS WHEN ATTACHING THIS PLUG

mounted upon the side of the plug. This spring also serves to hold the plug securely in the socket. The tip contact has a play of approximately 3/16 in. (4.8 mm.) and is so controlled by the spring that perfect contact is made even when the plug is pushed into the socket only far enough to hold by the first thread. Since this attachment may be pushed directly into a socket, no twisting of the wires results. This snap plug, the manufacturer points out, may also be easily inserted into a socket which has a shade mounted upon it. Heavily glazed porcelain is employed so that the plug may be kept clean without undue effort.

Canopy Tap

The Bryant Electric Company of Bridgeport, Conn., has added to its "New Wrinkle" line of wiring devices a canopy tap of wide application which can be readily attached to any ceiling or side-wall fixture where a current tap is desired. The new tap receives any "New Wrinkle" body, and many useful combinations can be made. By connecting the tap in series with the fixture and combining with a "New Wrinkle" key or pull switch for wall fixtures or a "New Wrinkle" pull ceiling switch for ceiling fixtures, conve-



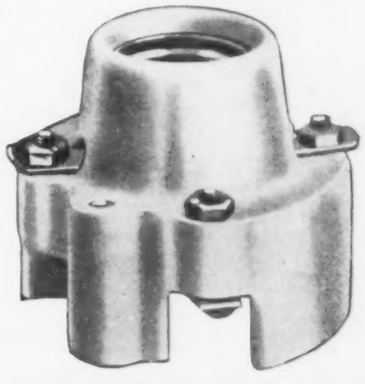
MANY COMBINATIONS CAN BE MADE WITH THIS TAP

nient means is provided for controlling single or group lamp fixtures at the fixture without expensive wiring—an especially valuable feature in rooms having no flush switches.

The new device, which is known as the "BZ New Wrinkle canopy tap," is National Electrical Code standard and consists of a "New Wrinkle" ring and a porcelain base, which are easily and firmly attached to the outlet box by means of stamped steel rings, rings being made to fit 3¼-in. and 4-in. (8.2-cm. and 10-cm.) boxes. In lath and plaster construction, the rings are omitted and the base is attached by wood screws. After notching the canopy to fit over the neck of the tap it can be replaced flush with the ceiling or wall, resulting in a neat and unobtrusive job.

Thermo Sign Flashers

The prominent features of the flasher shown in the accompanying illustration are that it consumes no energy when the lamp is out, thus saving 35 to 50 per cent in energy consumption. The socket flashers are built for 25, 40 or 60-watt lamps, as well as for 25-40 watt and 40-60 watt lamps. The second mentioned will operate either a 25-watt or a 40-watt lamp with change in adjustment, the last either a 40-watt or a 60-watt lamp. The device consists of two parallel bars made from the same



BURNS NO ENERGY WHEN LAMP IS OUT

die and stock, so that they will expand and contract together under any climatic changes, making the length of the flash and its duration always uniform in times per minute regardless of the sign load. This flasher is made by the M. C. Ryan Company of Phoenix, N. Y.

Trade Notes

JOHN L. COLLINS has taken new and better quarters at 405 Sun Building, Lowell, Mass.

CHASE & HOWLAND, New Bedford, Mass., have formed a partnership for the practice of industrial engineering.

THE GENERAL ELECTRIC COMPANY, Harrison, N. J., has issued, as of December, 1917, what is termed a "Conservation Number" of the "Edison Sales Builder."

THE NAGLE CORLISS ENGINE WORKS of Erie, Pa., builders of air compressors, vacuum pumps and engines, has opened an office in the Bourse Building, Philadelphia.

THE ARTHUR JONES ELECTRIC COMPANY of Chicago had an informal housewarming and dance in honor of the opening of its new plant, at 2837-2843, South State Street, Dec. 22.

N. B. PAYNE has opened an office in the Havemeyer Building, 25 Church Street, New York, as an electric crane specialist. Mr. Payne was formerly associated with Manning, Maxwell & Moore, Inc., New York City.

G. A. SCHNEIDER, formerly of the Western Electric Company's San Francisco sales organization, has been appointed manager at its Buffalo house, succeeding J. W. Tabb, who has been transferred to the New York house.

THE RIDGWAY DYNAMO & ENGINE COMPANY, Ridgway, Pa., announces the appointment of the Blake Electric Manufacturing Company, No. 1 Rowe's Wharf, Boston, as its sales representative for the New England States.

R. T. GRAY, 1644 First National Bank Building, Chicago, who was formerly connected with the Shuman Advertising Agency, has opened an advertising agency under his own name to handle technical advertising copy exclusively.

P. H. BOOTH, now an officer of the Hotpoint Electric Heating Company, will be a vice-president as well as sales manager of the new Edison Electric Appliance Company, of which a full account was given in the ELECTRICAL WORLD for Dec. 15.

W. C. CARTER has been placed in charge of the sales office at Grand Rapids, Mich., of the Westinghouse Electric & Manufacturing Company for the handling of western Michigan business. This office is under direction of the company's Detroit office.

THE BLAW-KNOX COMPANY has closed its Philadelphia office for the present, and Mr. Pulis, who had been in charge, is transferred to its San Francisco office, to take the place of Mr. Burrows, who is going into the service of the government.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., has completed and has about ready for operation the new factory site located east of the present office building. The structure will give additional working space of about 20,000 sq. ft.

THE BROWN COMPANY, Portland, Me., formerly the Berlin Mills Company, has acquired the property and business of the Burgess Sulphite Fibre Company. The new company will be carried on under the same control and management as heretofore, dealing in, among other things, a line of fiber conduit.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has recently completed an eight-story reinforced-concrete building. The buildings contain more than 20 acres of floor space. The yard space covers an area of 4 acres and tracks from two railroad lines run directly into the yards of the works.

H. T. GLOVER, formerly sales manager of the Esterline Company, Indianapolis, Ind., who enlisted last June with the Canadian Expeditionary Force, is about to start for Europe, if he has not already done so, as a member of the divisional signalers of the Canadian forces. Mr. Glover is a British subject, which accounts for his enlistment in Canada.

J. J. PORTLEY, recently connected with the selling force of the Western Electric Company, Minneapolis, Minn., and also previously representing the company on the Pacific Coast and in Chicago, is now in charge of the appliance department at 463 West Street, New York City. Mr. Portley will devote his entire time to mapping out and putting into execution energetic sales campaigns on these specialties.

THE GENERAL ELECTRIC COMPANY of Lynn, Mass., will soon begin the construction of three new buildings. The plans call for a two-story brick and concrete office building, 142 ft. by 60 ft.; a one-story building, 226 ft. by 582 ft., to be constructed of steel, brick, concrete and cement plaster, to be used for general manufacturing purposes, and a two-story building, 67 ft. by 340 ft., to be used for a cleaning and core shop.

THE HESS-BRIGHT COMPANY of Philadelphia, Pa., has closed its retail office at 934 North Broad Street, that city, owing to the enlistment of Rush S. Whiteside, the local manager, and G. L. Jenks, his assistant, in the aviation section of the United States Army. The Ahlberg Bearing Company of Chicago will open a branch house at the same address, and will represent the Hess-Bright Company as local distributers for the retail trade.

W. G. LAWRENCE has opened an office in the Spitzer Building, Toledo, Ohio, to engage in electrical engineering, and will make a specialty of power plant designing, street lighting and supervision of construction and electrical installations. One of the associates of Mr. Lawrence is H. A. Seward, who recently came to Toledo from Chicago to join this firm. Mr. Lawrence, also a Chicago engineer, established himself in Toledo several years ago.

THE GOULDS MANUFACTURING COMPANY of Seneca Falls, N. Y., has put into effect, beginning Jan. 1, 1918, a bonus system whereby all houriy, piece work and salaried employees rated at $40 a week or under will receive quarterly a bonus of 10 per cent on their total salary for the previous three months. This bonus is contingent upon a stipulated amount of time being put in at actual work during the year and is aimed to encourage full-time work.

S. F. FORBES, former manager of the Los Angeles office of Fairbanks, Morse & Company, is now the Pacific Coast manager, with that city as his headquarters. He will have jurisdiction over the San Francisco, Portland, Seattle, Spokane and Los Angeles offices. The territory covered includes California, Arizona, Nevada, Oregon, Washington, Alaska, Hawaiian Islands, northern Idaho and western Montana, besides Baja California, Sinaloa and Sonora, Mexico.

L. E. VAN NORMAN, chief of the division of information, Washington, D. C., has compiled a war trade manual for shippers. Since some of the data in the "Rules and Regulations of the War Trade Board," which has been distributed very widely throughout the country, have now been superseded by new rulings and lists, the division of information of the board is preparing a "War Trade Board Manual for Shippers," which will contain only data in force at the time of its publication.

THE AMERICAN CHAMBER OF COMMERCE of Mexico has just been oganized in the City of Mexico by American residents, companies and individuals. This chamber will publish printed matter about the country and its resources. Plans are being made for a periodical market reporter and news bulletin. An especial aim will be to furnish to the United States reliable business information about Mexico and also to keep in touch with the needs of its own country. The chamber will open a reading room, with American newspapers and magazines on file.

THE THORDARSON ELECTRIC MANUFACTURING COMPANY of Chicago has recently undergone a reorganization in all departments. A. S. Lindstrom, who is now general manager of the company, had become quite well known in the industry through his connection with the St. Louis and San Francisco World's Fairs. At the St. Louis fair Mr. Lindstrom was assistant chief of the Electricity Building. Later he became connected with the Western Electric Company in the Southwestern States, where he was engaged in marketing telephone apparatus. In the same territory he financed, built and operated four independent telephone companies. Later he was made assistant chief and director of high-voltage research work in the Machinery Palace at the San Francisco fair. After the fair, he became Western representative for the Thordarson Electric Manufacturing Company, which position he held until he came to Chicago to take up his present work. H. A. Johnson, the new sales manager of the company, has been employed in central station operating and general commercial activities with the Public Service Company of Northern Illinois, the Hot Point Electric Heating Company and the Electric Appliance Company. C. B. Olson, purchasing agent of the company, is new in the industry. He is also vice-president of the Olson Rug Company. C. R. Oschgar is production manager. The company has also appointed Mr. Alumbough as Central Western representative and Mr. Gibson as Eastern representative. W. I. Otis and the Western Engineering Sales Company continue to represent the Thordarson company on the Pacific Coast.

Trade Publications

TURBO-GEAR.—The Poole Engineering and Machine Company of Baltimore, Md., is distributing its bulletin No. 100, descriptive of its turbo-gear.

CENTRIFUGAL PUMPS.—The Manistee Iron Works Company of Manistee, Mich., has issued bulletin No. 53, descriptive of its single-stage centrifugal pumps.

ELECTRIC FURNACES—The Electric Furnace Company of Alliance, Ohio, has prepared a bulletin descriptive of its Bailey automatic electric furnaces for the heat treatment of high explosive and shrapnel shells.

FIXTURES—The Peter Forg Manufacturing Company of Somerville, Mass., has prepared a bulletin descriptive of its universal adjustable electric light fixtures, which are adapted for use in factories, offices, architect's designing and reading rooms, hotels and dentists' rooms, etc.

BUCKETS.—Catalog 44, descriptive of Hayward buckets for industrial plants, has been recently issued by the Hayward Company, 50 Church Street, New York City. This book not only gives photographs of such installations but also gives blueprint elevations and plans of the several forms of Hayward buckets operated by overhead traveling cranes, monorail hoists, inclined-boom unloaders, etc.

CALENDAR.—The Youngstown Sheet & Tube Company, Youngstown, Ohio, has issued a very attractive calendar for 1918. It is featured by twelve large two-color illustrations of as many different operations in the manufacture of iron and steel. The plates were made from photographs taken in the works of the company and are both handsome and instructive. The calendar will be sent to any address on receipt of 4 cents in stamps to pay cost of mailing.

LEFAX DATA BOOKS.—The Lefax Company of Philadelphia, is distributing catalog sheets for the following firms for Lefax loose-leaf books: SKF Ball Bearing Company, Hartford, Conn., ball bearings, hangers and fall blocks; Electric Weighing Company, New York, automatic belt conveyor scales; Atlantic Terra Cotta Company, New York, firebrick. It is pointed out that each of these sheets is punched and indexed for filing in the Lefax data books in use by so many engineers, although they would, of course, interest any person having occasion to use such products.

INDUSTRIAL APPARATUS.—In its catalog 8-E, just issued, the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has grouped all of the industrial electric heating apparatus which it manufactures. The line includes steel-clad heaters for many industrial processes, immersion-type water heaters, stoves of various forms, chocolate warmers, tailors' irons and electric oven heaters for use in enameling. Data are given for the calculation of the proper amount of heating to provide for water and for the heating of buildings. Several pages are devoted to the subject of electrically heated ovens, covering the design and construction of the ovens themselves, a discussion of the various types and their uses, and the efficiencies in operation which can be secured. Westinghouse electrical heaters, which are of the ribbon type, are described and also the company's system of thermostatic control. A considerable number of circuit diagrams are given, showing various methods of applying these control devices. Inclosed with the catalog is a data blank showing the information which should be furnished by any user of electrically heated ovens in order to enable the company to arrive at the proper number and type of heaters for his service. This catalog is a valuable addition to the library of any man whose work includes the application of heat at moderate temperatures for industrial purposes.

New Incorporations

THE STANDARD ELECTRIC MANUFACTURING COMPANY of Jersey City, N. J., has been chartered with a capital stock of $200,000 by Jules E. Brand, H. A. Black and Walter T. Hilton, all of Jersey City, N. J.

THE CLEVELAND (OHIO) CONTROLLER & MANUFACTURING COMPANY has been chartered with a capital stock of $20,000 by L. C. Spieth, L. A. O'Neil, N. M. Strine, M. E. Gleason and M. G. Egan.

THE EBERT ELECTRIC COMPANY of Crary, N. D., has been incorporated with a capital stock of $5,000 by J. H. Smith, F. R. Stevens and John W. Ebert.

THE N. DICKINSON COMPANY, 367 High Street, Newark, N. J., has been organized by N. Dickinson for the purpose of manufacturing lighting specialties.

THE AMHERST (WIS.) ELECTRIC SERVICE COMPANY has been incorporated with a capital stock of $25,000 by B. E. Dwinell, Hugh Evans and others.

THE BULLITT COUNTY ELECTRIC LIGHT COMPANY of Shepherdsville, Ky., has been chartered with a capital stock of $9,000 by S. W. Bates, C. L. Croan and S. H. Ridgway.

THE HERNDON (VA.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $15,000. The incorporators are: C. N. Florence, president, and E. E. Gillette, secretary.

THE HOFFMAN-HARBER COMPANY of Fort Wayne, Ind., has been incorporated to deal in electrical apparatus. The incorporators are: Henry Hoffman, Fred Harber and Howard Benninghoff.

THE AKRON (OHIO) BATTERY & ELECTRIC COMPANY has been chartered with a capital stock of $2,500 by W. C. Kimball, E. J. Schultz, E. S. Sheck, O. E. Sellers and N. E. Herwick.

THE RAILWAY UTILITIES & EXPORT COMPANY of New York, N. Y., has been chartered with a capital stock of $10,000 by F. H. Martinell, H. C. Niemeyer and G. A. Reiss, 165 Broadway, New York.

THE MANHATTAN STORAGE BATTERY COMPANY of New York, N. Y., has been chartered with a capital stock of $9,900 by A. J. Picard, E. J. Stern and A. Hirst, 2008 Broadway, New York, N. Y.

THE DAYTON (OHIO) ELECTRICAL MANUFACTURING COMPANY has been organized by H. G. Catrow, William V. Knoll, Vincent G. Apple, I. Webb and Earl H. Turner. The company is capitalized at $125,000.

THE B. B. BELL COMPANY of Los Angeles, Cal., has been incorporated with a capital stock of $30,000 to manufacture lighting fixtures, etc., The incorporators are B. B. Bell, E. P. Bell and D. S. Collins of Los Angeles.

THE ALAMO FARM LIGHT COMPANY of Wilmington, Del., has been incorporated with a capital stock of $60,000 to conduct electric light plants. The incorporators are: F. D. Buck, M. L. Horty, K. E. Longfield, all of Wilmington, Del.

THE G. A. ELECTRIC MANUFACTURING COMPANY of Cincinnati, Ohio, has been incorporated by George R. Adams, Sr., George R. Adams, Jr., Julius H. Schatzman, E. C. Daupre and George Code. The company is capitalized at $10,000.

THE CITIES FUEL & POWER COMPANY of Dover, Del., has been incorporated by L. B. Phillips and J. B. Bailey of Dover, Del. The company has capital stock of $10,000,000 and proposes to operate plants to generate and distribute electricity and gas.

THE HORN & BRANNON MANUFACTURING COMPANY of Trenton, N. J., has been incorporated by Herman Corn and Frederick Pfeffer of Philadelphia, Pa. The company is capitalized at $60,000 and proposes to manufacture gas and electric fixtures, etc.

THE ATLANTIC ELECTRIC GOODS COMPANY of Queens, N. Y., has been incorporated with a capital stock of $50,000 by P. J. Shelley, J. J. Wesley and C. L. Eidlitz, St. Regis Hotel, New York, N. Y. Joseph J. Wesley of Douglaston, and P. J. Shelley of Oceanside.

THE BOS GENERAL CORPORATION OF AMERICA, of New York, N. Y., has been incorporated by W. A. Noble, F. and R. Bos, 90 West Street, New York, N. Y. The company is capitalized at $100,000 and proposes to do a general electrical and mechanical engineering business.

THE PORTER ELECTRIC LINE COMPANY of Stebbinsville (not a post office), Wis., has been chartered with a capital stock of $10,000 to develop a water power at Stebbinsville and furnish electricity to rural districts within a radius of 10 miles of Stebbinsville. Fred Miller is president.

THE NEW YORK ELECTRIC RECTIFIER CORPORATION of Newark, N. J., has been incorporated by James M. Clark of East Orange; George W. Downs of Madison, and Frank E. Richards of Glen Ridge, N. J. The company is capitalized at $50,000 and proposes to manufacture electrical apparatus.

THE IOLA (WIS.) LIGHT & POWER COMPANY has been incorporated by Edlin J. George, Bertha and Erna Nehls. The company is capitalized at $25,000 and proposes to construct and operate a hydro-electric and an auxiliary steam-generating plant, saw and planing mill and other industries.

THE MOUNTAIN STATES POWER COMPANY of Wilmington, Del., has filed articles of incorporation with a capital stock of $15,000,000 to generate and distribute electricity for lamps, heaters and motors. The incorporators are: C. L. Rimlinger, M. M. Clancy, Clement M. Egner of Wilmington, Del.

FREDERICK N. WHITNEY of Brooklyn, N. Y., has filed articles of incorporation with a capital stock of $25,000 to build heating, lighting, ventilating, water supply, sewage disposal plants, etc. The incorporators are: F. N. Whitney, L. C. Whitney, 1233 Pacific Street, Brooklyn, and H. W. Hase, 305 Sixth Avenue, Brooklyn, N. Y.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

New England States

HOULTON, ME.—A large dam has been completed at Aroostook Falls for the Maine & Aroostook Power Company, which supplies electricity for lamps and motors in Houlton, Van Buren and all intermediate towns, and also for the Aroostook Valley Railroad, which operates heavy freight and passenger traffic through Northern Aroostook with terminals at Washburn, Caribou and New Sweden. The company, it is understood, will build an extension to its power plant.

SKOWHEGAN, ME.—The Central Maine Power Company is planning a water power development at Skowhegan, involving an expenditure of about $1,000,000. The company owns all the water power rights in the town, the Savage Manufacturing Company and the Skowhegan Pulp Company's power rights, and it has recently purchased the Bombazee Rapids, three miles above Norridgewock. Under the proposed plans the main dam at Skowhegan Falls is to be raised 7 ft. Part of the dam is built of concrete and this only will be raised, while the other half will be entirely rebuilt. It is estimated that 25,000 hp. can be developed. Definite plans have not yet been decided upon.

CAMBRIDGE, MASS.—A permit has been granted to the Worthington Pump & Machinery Corporation, as agent for the United States government, for a power plant building, 70 ft. by 90 ft., one story and mezzanine, to be erected on Binney Street, between Third and Fifth Streets. The cost is estimated at $60,000. The Aberthaw Construction Company is architect and builder.

EVERETT, MASS.—The General Electric Company is planning to erect a new foundry, one story, at its local plant, to cost about $35,000.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company has disposed of its inside wiring business and electrical fixtures and appliances and will close its salesrooms. This is a war measure which has been decided upon by reason of so many men employed by the company having entered military service.

NEW BEDFORD, MASS.—Plans have been filed by the Harry M. Hope Engineering Company for the erection of the new power station to be erected at the foot of Middle Street for the Union Street Railway Company. The new building will be 98 ft. by 126 ft. and will cost about $300,000.

CHESHIRE, CONN.—The power house at the Farnum lime plant was recently damaged by fire, causing a loss of about $5,000. The electric plant was put out of commission.

NORWICH, CONN.—Work, it is expected, will begin in the spring on the new steam power plant of the Eastern Connecticut Power Company at Thamesville. From the proposed power station a high-tension transmission line will be erected to furnish energy to the Groton Iron Work with which the Shore Line Electric Railway Company has a ten-year contract. The balance of the power generated at the plant, it is expected, will be made use of by the various public utilities companies in the territory through which the Shore railway company operates, which has already high-tension lines extending on the west to Guilford, east to Rhode Island and north to Putnam and South Windham.

STAMFORD, CONN.—The John Davenport Company of Stamford, which has taken over the Ross Engineering Company of Bridgeport and the Steinmetz Electric Truck Company of Newark, N. J., contemplates the construction of a new factory, 90 ft. by 300 ft. The company will manufacture gasoline engines and electric trucks.

WATERBURY, CONN.—Contract has been awarded by the International Silver Company of Meriden to Lewis A. Miller, 21 Church Street, Meriden, for the construction of a new one-story power house, about 45 ft. by 80 ft., at its local plant on Silver Street.

Middle Atlantic States

BINGHAMTON, N. Y.—The Binghamton Light, Heat & Power Company will soon begin work on the installation of two 600-hp boilers, together with stokers and forced draft fan. The company has recently been awarded a contract by the Binghamton Cold Storage Company to supply electrical service to the amount of 100 hp.

BOMBAY, N. Y.—Application has been filed with the Public Service Commission by the Bombay Electric Corporation for permission to issue $2,000 in capital stock, of which it is proposed to use $700 at once.

BROOKLYN, N. Y.—The installation of a new electric-lighting system at the local navy yard, to cost about $8,000, is under consideration by the Bureau of Yards and Docks, Navy Department, Washington, D. C.

BROOKLYN, N. Y.—Plans have been filed by the Transit Development Company, a subsidiary of the Brooklyn Rapid Transit Company, for an addition to its electric generating system at Kent and Division Streets.

BUFFALO, N. Y.—Plans are being prepared by the Kittinger Furniture Company, 15 Front Avenue, Buffalo, for the construction of an addition to the power house at its plant at 1893 Elmwood Avenue.

JOHNSTOWN, N. Y.—The City Council has accepted the new contract presented by the Fulton County Gas & Electric Company for lighting the streets of the city. The new contract calls for 19 type C lamps of 600 cp., 72 lamps of 400 cp. and 280 incandescent lamps of 60 cp. The lamps under the new contract will be arranged throughout the city under the same system as that used at present.

LOCKPORT, N. Y.—The Lockport Light, Heat & Power Company has filed a petition with the Public Service Commission for permission to issue $150,000 in capital stock.

NEW YORK, N. Y.—Preparations are being made by the Washburn Wire Company, 117th Street, New York City, manufacturer of insulated wire, etc., for rebuilding its plant, recently destroyed by fire. The cost of the new plant is estimated at $350,000.

THIELLS, N. Y.—Bids will be received by Frank A. Vanderlip, president of the board of managers of Letchworth Village, Thiells, 7 Wall Street, New York, N. Y., until Jan. 3 for construction, heating, plumbing and electric work for attendants' home and service building at Letchworth Village. Drawings and specifications are on file at the office of the board of managers, 7 Wall Street, New York City, and at the New York office of the Department of Architecture, 1224 Woolworth Building. Copies may be obtained at the Department of Agriculture, Capitol, Albany, N. Y. Lewis F. Pilcher is State architect.

HIGHTSTOWN, N. J.—The Borough Council is considering improvements to the water-works system, including the installation of new power equipment.

HOPEWELL, N. J.—The Borough Council has awarded the Public Service Electric Company a contract for lighting the streets of the borough for a period of one year.

JERSEY CITY, N. J.—Plans are being considered by the City Commission for the installation of an underground conduit system for its police and fire-alarm department to replace the present overhead wires, together with other improvements.

PRINCETON, N. J.—The installation of an underground conduit system on Stockton Street has been completed. The Borough

Council is planning to place the remaining overhead transmission wires in underground conduits.

SKILLMAN, N. J.—The Philadelphia & Reading Railroad Company of Philadelphia, Pa., is planning to erect a new power house and signal tower at Skillman for which plans have been prepared.

TRENTON, N. J.—A portion of the car barns and shop of the Trenton & Mercer County Traction Corporation on Lalor Street was destroyed by fire on Dec. 14, causing a loss of about $70,000. The company has recently awarded a contract for an additional 2000-hp. generating unit at its power house on Lincoln Avenue.

ALTOONA, PA.—The Penn Central Light & Power Company has filed notice with the Public Service Commission of an issue of $15,000 in bonds for improvements, extensions, etc.

GREENSBURG, PA.—The County Commissioners have awarded a contract for the installation of 16 ornamental lamps around the court house square to the Greensburg Gas & Electric Company at $60 each per year.

LANCASTER, PA.—Notice has been filed by the Conestoga Traction Company with the Public Service Company of an issue of car-trust certificates to the amount of $50,000 for improvements, extensions and other purposes.

NEW CASTLE, PA.—Notice has been filed by the Mahoning & Shenango Railway & Light Company with the Public Service Commission of an issue of $250,000 in bonds. the proceeds to be used for extensions and improvements.

PHILADELPHIA, PA.—Plans have been prepared by the Bell Telephone Comp Seventeenth and Arch Streets, for extensive alterations and improvements to its administration building at Eleventh and Filbert Streets.

PHILADELPHIA, PA.—An ordinance has been passed by the City Council providing for improvements to the electric street-lighting system, which will include the installation of additional lighting units and the relocation of certain lamps forming part of the system.

PHILADELPHIA, PA.—The United States government has requestedthe Philadelphia Electric Company not to take on any new electrical contracts whatever, and to conserve as much as possible with regard to those already in force. This order was given for war purposes. particularly for the development of the building at Hog Island and the construction of the large ships there.

READING, PA.—The Wilmington & Northern Railroad Company has awarded a contract to the Tri-County Electric Company for furnishing electricity to operate the pumps at the new water station now being erected for the Reading-Wilmington line of the company.

SCRANTON, PA.—The Scranton Electric Company is installing several large boilers at its power plant.

NEW CASTLE, DEL.—The Penn Seaboard Steel Corporation, 111 Broadway, it is reported, is planning to erect a new steel mill and power house between Wilmington and New Castle at a cost of about $2,000,000. The power house will cost about $300,000.

BALTIMORE, MD.—Plans have been prepared by the Consolidated Gas, Electric Light & Power Company for the erection of a new electric distributing station at Custom House Avenue and Water Streets, to cost about $10,000.

SECURITY, MD.—Work is progressing rapidly on the improvements to the local power plant of the Hagerstown & Frederick Railway Company, which when completed will double the output now obtained from the plant.

BLUEFIELD, W. VA.—The Norfolk & Western Railway Company is contemplating the construction of approximately 16 miles of new track from Kimball to Farm and Wilcox, during 1918.

CHARLESTON, W. VA.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., has awarded contract for construction of an electric conduit system at the United States naval projectile plant to the G. E. Engineering Company, New York, N. Y., at $8,988.

FAIRMONT, W. VA.—The Monongahela Valley Traction Company contemplates the construction of 4 miles of new track in Fairmont during 1918 and to rebuild 1 mile of new track.

HERNDON, VA.—The Herndon Light & Power Company, recently incorporated with a capital stock of $15,000, proposes to construct and operate an electric-light plant in Herndon. C. N. Florence is president and E. E. Gillette is secretary.

North Central States

GRAND RAPIDS, MICH.—The Grand Rapids Railway Company, it is reported, is considering the construction of a cross-town extension to the northeastern section of the city.

GRAND RAPIDS, MICH.—The new junction dam on the Manistee River of the Consumers' Power Company is nearly completed and, it is expected, that it will be put into service early in January. It is estimated that about 22,000 hp. will be developed, which will be transmitted to Grand Rapids via Croton. The company has two new developments under construction on the Au Sable River. One of these, which it is estimated will develop about 10,000 hp., will be completed the latter part of January. Power generated at this plant will be utilized in the eastern part of the State.

AKRON, OHIO.—Extensions are being made to the local plant of the Wellman-Seaver-Morgan Company of Cleveland, which will include a power house, a galvanizing plant and a crane runway.

CANTON, OHIO.—The power plant at Windsor, after having been closed for several months, has resumed operations and is now supplying energy in Canton.

PORTSMOUTH, OHIO.—The Portsmouth Street Railroad & Light Company is planning to build 2 miles of new track between Portsmouth and Union Mills during 1918.

OWENSBORO, KY.—Notice has been filed by the Owensboro Home Telephone & Telegraph Company of an increase in capital stock from $10,000 to $100,000, the proceeds to be used for extensions, improvements, etc.

SHEPHERDSVILLE, KY.—The Bullitt County Electric Company, recently incorporated, proposes to operate an electric plant in Shepherdsville and surrounding towns. The incorporators are: S. M. Bates, C. L. Croan and S. H. Hidgway. The company is capitalized at $9,000.

FORT WAYNE, IND.—The Board of Works has awarded the contract for the construction of an addition to the municipal electric-light plant to Buesching & Hagerman, at $26,015. The contract for smokestack was awarded to the Custodis Company, at $8,440.

CHICAGO, ILL.—The general contract for the construction of a factory, 87 ft. by 250 ft., one-story, to cost about $30,000, in connection with a plant being erected on Waller Avenue and Taylor Street for the Hughes Electric Heating Company, 5660 Taylor Avenue, has been awarded to the Abraham Lund Company, 19 South La Salle Street.

CHICAGO, ILL.—Plans are being prepared, it is reported, by the Chicago Surface Lines for extensive additions to its carhouses at North Clark Street and Schreiber Avenue, to provide space for about 300 cars. A one-story power house and two-story office building will probably be included in the project. No construction work, it is understood is contemplated in the near future. The cost of the entire work is estimated at about $500,000.

EAST ST. LOUIS, ILL.—The Excelsior Tool & Machine Company is planning extensions to its plant, including the erection of an addition to its foundry building, a two-story pattern shop, storehouse, stockroom and garage, for which, it is understood, bids have been asked. The company also contemplates the construction of a large core oven and will install a 10-ton and a 2-ton electric crane. T. F. Phillippi is president and manager.

HILLSBORO, ILL.—The Southern Illinois Light & Power Company of Hillsboro has applied to the Public Utilities Commission for permission to erect an electric transmission line from DuQuoin to Pinckneyville to furnish electricity for lamps and motors to adjacent territory.

AMHERST, WIS.—The Amherst Electric Service Company, recently incorporated with a capital stock of $25,000, proposes to operate an electric plant in Amherst. Among the incorporators are: B. E. Dwinnell, Hugh Evans and others.

IOLA, WIS.—The Iola Electric Light & Power Company is planning to change its plant from direct to alternating-current system. New machinery, including engines, generators and transformers will be installed. Meters and poles will be required. J. N. Cadby, Washington Building, Madison, is consulting engineer.

RACINE, WIS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 7 for conduit and wiring system, lighting fixtures, etc., for the United States post office and custom house in Racine. Drawings and specifications may be obtained at the above office or the custodian of the building at Racine.

STEBBINSVILLE, WIS.—The Porter Electric Line Company, recently incorporated with a capital stock of $10,000, is planning to develop water power at Stebbinsville and furnish electricity to rural districts within 10 miles of Stebbinsville. Fred Miller is president of the company. Stebbinsville has not a post office.

DEER RIVER, MINN.—Owing to the difficulty in securing equipment, etc., the installation of the second generating unit in the power plant of the Minnesota Utilities Company has been delayed. When completed a 24-hour service will be established.

DULUTH, MINN.—The Duluth Edison Electric Company has petitioned the City Council for permission to extend its three-phase, 2300-volt feeder line through New Duluth past the pumping station of the Light and Water Department.

LOUISBURG, MINN.—Bonds to the amount of $2,500 have been voted for the installation of an electric-light system in Louisburg.

ST. PAUL, MINN.—With the understanding that no work will be attempted until after the war, the City Council has requested the Department of Public Works to report on the feasibility of establishing a municipal lighting, heating and power plant.

SEBEKA, MINN.—The Council has asked the Little Falls (Minn.) Water Power Company of Minnesota to erect an electric transmission line to Sebeka to furnish electrical service here.

VIRGINIA, MINN.—The power plant of the Virginia & Rainy Lake Lumber Company was damaged recently by an explosion. The company supplies power to operate the municipal electric-light plant. The reserve plant of the city has been put into commission.

GARNER, IOWA.—The local electric-light plant of the Iowa Falls Electric Company was recently destroyed by fire, causing a loss of about $10,000.

LE MARS, IOWA.—The new power plant of the Iowa Light, Heat & Power Company will be completed about Jan. 1. The electric transmission line to Remsen is nearly finished and will soon be connected with the plant. When completed the power station will supply electricity in Alton, Orange City, Remsen and Kingsley. Other towns will be added later. Additional units, it is expected, will be added next spring.

MANCHESTER, IOWA.—The Iowa Electric Company of Cedar Rapids, owner of the local electric plant, has submitted a proposal to the City Council to sell the plant to the city. The company recently acquired the properties of the Manchester Light, Heat & Power Company and of E. W. Hoag in Manchester.

OZARK, MO.—The Finley Light Company, recently incorporated with a capital stock of $10,000, proposes to operate a mutual electric-light plant. John C. Rogers, D. W. Bingham and others are incorporators.

GROTON, S. D.—The Groton Light, Heat & Power Company is contemplating the erection of an electric transmission line from Ashton to Conde and from Conde to Verdon and Ferney, thence to Groton and on to Andover.

BAYARD, NEB.—Bonds to the amount of $4,500 have been voted for the installation of an ornamental lighting system.

LARNED, KAN.—Plans are being considered to extend the electric transmission line of the municipal electric-light plant from the State Hospital of the Insane, located 3 miles west of Larned, to the town of Gillespie, a distance of 11 miles, to furnish electricity in the latter place.

Southern States

GREENSBORO, N. C.—The Greensboro Supply Company, it is reported, is in the market for the following second-hand machinery: One 300 to 400-kw., three-phase, 60-cycle, 550 or 2300-volt, revolving field alternator, directly connected to cross-compound condensing Corliss engine; one 500-kw., three-phase, 60-cycle, 550-volt, revolving field alternator, direct-connected to a simple engine. Complete specifications to be furnished, giving condition of equipment.

CHARLESTON, S. C.—Contract has been awarded by the Navy Department, Washington, D. C., for improvements to the power plant at the Charleston Navy Yard to Gillis & Geoghegan, 537 West Broadway, New York City, at $119,875.

COLUMBIA, S. C.—Surveys have been completed by the Columbia Railway & Navigation Company for its proposed electric interurban railway from Columbia to Greenwood, via Lexington and Saluda, a

distance of about 75 miles. Construction of the railway has been deferred on account of financial, material and labor conditions. T. C. Williams is vice-president and general manager and Frank H. Halskell is chief engineer of Columbia.

ATLANTA, GA.—The Alabama Street substation of the Georgia Railway & Power Company was recently damaged by fire, causing a loss of about $2,000.

EAST POINT, GA.—The Couch Mills Company is planning to erect two mill buildings, one 200 ft. by 60 ft. and the other 150 ft. by 50 ft. The equipment will include 108 looms equipped for electric-motor drive. Most of the machinery, it is understood, has been purchased. J. L. Denman of East Point is engineer.

SAVANNAH, GA.—The Savannah Electric Company is considering the construction of an extension to Fort Wentworth, a distance of about 5 miles.

ARCHER, FLA.—The Maddox Foundry & Machine Company, it is reported, would like to receive prices on equipment for electric-lighting plant, direct current. H. Maddox is president and manager.

BONIFAY, FLA.—Bids will be received by the Town Council at the office of the town clerk until Jan. 3 for the construction of an electric-light plant and waterworks system. Plans and specifications may be obtained at the office of the J. B. McCrary Company, engineer, Third National Bank Building, Atlanta, Ga. Charles E. Terry is town clerk.

JACKSONVILLE, FLA.—Plans are being considered by the committee on water and electricity for the erection of an electric transmission line to the State Fair Grounds.

KINGSPORT, TENN.—The new electric-lighting system installed by the Kingsport Utilities Company from Dale Street to the plant of the Federal Dyestuff & Chemical Corporation has been put into operation. It is expected to have the entire lighting system for the business and residential sections in service by the first of the year.

FOLEY, ALA.—The city of Foley is considering issuing $3,000 in bonds, the proceeds to be used to construct or purchase an electric-light plant.

HANCEVILLE, ALA.—The Stouts Mountain & Hanceville Railroad Company, it is reported, contemplates the construction of a railway between Hanceville and Stoutsville, a distance of 6 miles. Charles F. Wheelock of Birmingham is reported interested.

MOBILE, ALA.—The Mobile & Ohio Railroad Company is contemplating improvements to grain elevator, involving an expenditure of about $100,000. It is proposed to rebuild a 250,000-bu. elevator and equip it with electrically-operated machinery. R. V. Taylor is vice-president.

NEW ORLEANS, LA.—Bids will be received by the Board of the Port of New Orleans, Suite 200, New Orleans Court Building, until Jan. 9 for furnishing and installing a complete fire protection and sprinkler system, including motor-driven centrifugal underwriters' pumps and complete electrical installation for same, for portions of the cotton warehouses and terminals now under construction on the east bank of the Mississippi River between Valence and Soniat Streets. Plans and specifications are on file at the office of Ford, Bacon & Davis, 921 Canal Street, copies of which may be obtained upon deposit of $25.

SHEFFIELD, ALA.—Definite steps have been taken by the United States government for the construction of a cyanamide plant at Muscle Shoals, near Sheffield, to cost $30,000,000. Electricity to operate the proposed plant will be supplied by the Alabama Power Company, which has a three-year contract to furnish the service. Work has already begun on the erection of a transmission line from Warrior to the Muscle Shoals. The transmission line from the steam plant will be 190 miles long, including the new circuit from Warrior to Sheffield, which is 90 miles.

KENSETT, ARK.—E. D. Hardin, recently granted a franchise to supply electricity in Kensett, is planning to install an electric-light and power plant.

NEWPORT, ARK.—The Littleton Brothers Company, it is reported, is in the market for cotton gin and power plant equipment to replace that destroyed by fire recently. The loss is estimated at $12,500.

NEW ORLEANS, LA.—The New Orleans Railway & Light Company is planning to rebuild 5.7 miles of track during 1918.

NEW ORLEANS, LA.—Preparations are being made for the installation of the new ornamental lighting system on the principal thoroughfares of New Orleans leading from the Union Station to Canal Street. The plan provides for the erection of ornamental standards, each mounted with a 500-cp. nitrogen lamp.

DURANT, OKLA.—The Consumers' Light & Power Company is planning to rebuild and equip that portion of its electric plant damaged by fire.

TULSA, OKLA.—The Tulsa Street Railway Company is considering double-tracking its line on Main Street.

BRYAN, TEX.—The Bryan & Central Texas Interurban Railway Company contemplates the construction of 4 miles of new track between Newsome and Wilcox during 1918.

FORT WORTH, TEX.—The City Commission will ask the Northern Texas Traction Company to extend the Arlington Heights car line to Lake North, a distance of 8 miles. The company now operates a bus line from the end of the car line to the beach.

MART, TEX.—The installation of additional machinery at the waterworks station is under consideration by the City Council.

PORT ARTHUR, TEX.—The Port Arthur Light & Power Company is contemplating the installation of a water-treating plant, to cost about $16,000.

Pacific and Mountain States

SEATTLE, WASH.—Plans are being prepared by Daniel Huntington, city architect, for the construction of a new substation for the Municipal Lighting Department at West Forty-ninth Street and Fourteenth Avenue, N. W. The cost of the station with equipment is estimated at about $75,000. The proposed station will distribute electricity in the Ballard district as well as for the operation of the Ballard extension of Division "A" of the municipal street railway system. Bids, it is understood, will be asked for soon after the first of the year.

SEATTLE, WASH.—Plans are being considered for increasing the transportation facilities to the Duwamish Valley district in Seattle, where the new industrial plants have been located. One of the plans presented is the use of two five-car electric trains twice each day to run from Fifth Avenue and Jackson Street to Ninth Avenue South, skirting the foot of Beacon Hill and turning off at Lucille Street to run west to First Avenue South, and thence south on First Avenue to Fidalgo Street. The cost of installing this line is estimated at $65,000. The other is to use the shuttle system running along Lucille Street and First Avenue South, making transfer connections with the Georgetown and South Park cars, the cost of which is estimated at $45,000.

TACOMA, WASH.—Norton L. Taylor, engineer in the Department of Light and Water, has been appointed as special engineer to make surveys and estimates on increasing the storage capacity of the Nisqually basin of the power plant.

ASTORIA, ORE.—The Pacific Power & Light Company is considering making extensions to its local service to meet the increasing demands for electricity for industrial purposes.

ANAHEIM, CAL.—Preparations are being made for the installation of new machinery in the municipal electric-light plant, including a tandem cross-compound engine, an electric generator, exciter, boilers, pumps, etc., for which bids have been received.

BELLA VISTA, CAL.—The planing mill and electric plant of the Shasta Land & Timber Company was recently damaged by fire, causing a loss of about $70,000. The plant was under lease to the Shasta Commercial Company. Post office address Bella Vista, R. F. D. from Palo Cedro.

MERCED, CAL.—The San Joaquin Light & Power Company is erecting an electric transmission line from the new power house at the site of the Merced Stone Company's interests to Coulterville. The company has a franchise at the latter place and will install an electric street-lighting system.

SAN FRANCISCO, CAL.—Application has been made by the Pacific Gas & Electric Company to the Railroad Commission for authority to issue $3,000,000 in bonds, at not less than 85. Of the proceeds it is proposed to use $1,500,000 for electrical equipment and extensions, $1,000,000 for its gas department and $200,000 for miscellaneous purposes, during 1918.

SAN FRANCISCO, CAL.—At a meeting of the electrical interests with the State Railroad Commission held recently plans for combining all electrical power resources of California under one general management for the duration of the war, looking toward obtaining greater economy in operation and increased production were considered. F. Emerson Hoar, electrical engineer of the commission, was authorized to draw up a plan under which the combination can be effected.

SAN FRANCISCO, CAL.—The Southern Pacific Company, it is reported, will soon begin the work on erecting a high-tension transmission line from its Fernside power house to Webster Street, Alameda, and to remove the existing high-tension line from Lincoln Avenue. The cost of the transmission line is estimated at $60,000. The proposed new line will transmit energy from the main plant to the substations at West Oakland and Thousand Oaks. E. H. Miller is engineer in charge.

SANTA BARBARA, CAL.—The City Council is considering the installation of a municipal electric-light plant in Santa Barbara. The construction of a hydroelectric plant at Mission Tunnel is under consideration.

SANTA MONICA, CAL.—The City Commissioners have granted Erminio Gamberi a 25-year franchise to operate electric trams on the Ocean Front Promenade in Santa Monica.

PASADENA, CAL.—The Southern California Edison Company has submitted a new offer to the city for the purchase of the company's distributing system within the city limits. The former price named was $500,714; the new offer is $488,223. Further the company offers to sell energy on a 15-year contract, instead of a 30-year basis as was originally proposed. The city refused the first offer and began to purchase power from the city of Los Angeles.

MONTOUR, IDAHO.—Surveys are being made for the installation of an electrically-driven pumping plant for R. E. Noland to irrigate 2200 acres of land south and east of Montour. The cost is estimated at about $30,000. George Knowles is engineer.

NAMPA, IDAHO.—Plans have been completed by the Carnation Milk Products Company of Seattle for the erection of a plant in Nampa, to cost about $175,000. The plans include a three-story boiler house, 50 ft. by 100 ft.

SHELLEY, IDAHO.—The installation of a municipal electric-lighting plant in Shelley is under consideration.

YUMA, ARIZ.—The Southern Sierras Power Company has abandoned temporarily its project of extending its electric transmission line from Yuma through Gilabend to Ajo on account of the difficulty in securing equipment. The proposed line was to supply electricity to operate irrigation pumping plants and mining machinery.

HARLOWTON, MONT.—The city has awarded a contract to the Montana Power Company for the installation of an ornamental lighting system, to cost about $4,000.

MISSOULA, MONT.—The Missoula Light & Water Company has filed a notice of increase in capital stock from $1,000,000 to $1,500,000.

DENVER, COL.—The installation of a lighting system similar to that used at the San Diego Exposition (flood system) in the civic center has been decided upon by the Park Board. Underground wires to maintain the system have already been installed. Under the present plans the cost of maintenance is estimated at $4,000 per year.

Canada

BROCKVILLE, ONT.—Brockville will soon be linked up with the Ontario systems of the Hydro-Electric Power Commission by the transmission of 10,000 hp. from the Cedar Rapids Transmission Company, which at present is developing and furnishing from 60,000 to 80,000 hp. to the aluminum and other plants at Massena, N. Y.

MERLIN, ONT.—A movement has been started by the ratepayers to secure hydro-power service in Merlin.

MINDEN, ONT.—A committee has been appointed to secure an extension of the electric transmission line of the Hydro-Electric Power Commission of Ontario from Kinmount Junction to Minden.

WARKWORTH, ONT.—Steps have been taken to secure electrical service for the village of Warkworth and farmers residing along the line in Percy Township which will be erected from Campbellford.

WINDSOR, ONT.—The Water Commissioners have decided to install at once two high-power electrically-driven pumps on account of shortage of fuel. The present steam plant will be held for auxiliary purposes.

VALLEYFIELD, QUE.—The power house of the Montreal Cottons, Ltd., was recently destroyed by fire. Arrangements are being made to equip the plant for electrical operation.

Record of Electrical Patents

Notes on United States Patents

(Issued Dec. 4, 1917)

1,248,749. Electric Signal System; Nathan H. Suren, Needham, Mass. App. filed Feb. 8, 1915. Particularly for use where a multiplicity of code signals is required.

1,248,768. Storage Battery; Theodore A. Willard, Cleveland, Ohio. App. filed Jan. 10, 1916. Means for sealing the terminal posts in the cover.

1,248,782. Calling Mechanism for Party-Line Exchanges; Clarence A. Anderson, Chicago, Ill. App. filed March 30, 1911. Improvements.

1,248,787. Electrical Switch; Frank J. Backscheider, Cincinnati, Ohio. App. filed June 30, 1913. Switch in which the circuit may be automatically and instantaneously broken under predetermined conditions.

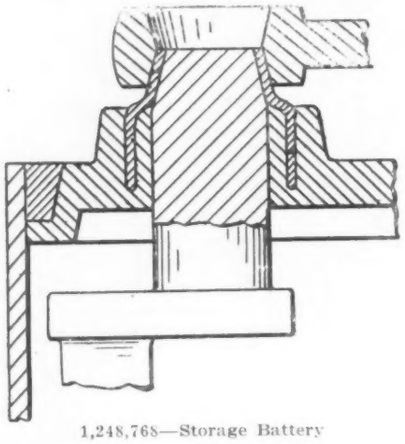
1,248,800. Electrically Heated Press for Clayware; Sebastian G. Brinkman, Ford, N. J. App. filed Sept. 6, 1917. Improvements.

1,248,812. Electrically Uniting Metals; Frederick A. Costello, Southbridge, Mass. App. filed Jan. 3, 1911. United by the melting away of the uniting material.

1,248,813. Electric Welding and Soldering; Frederick A. Costello, Southbridge, Mass. App. filed Dec. 22, 1913. Improvements.

1,248,828. Ignition Device; Burns Dick, St. Louis, Mo. App. filed July 19, 1915. Improved means for automatically causing the maximum explosion pressure to occur at an efficient point of the crank revolution under all load conditions.

1,248,829. Condenser Terminal and Method of Forming Same; Burns Dick,



1,248,768—Storage Battery

St. Louis, Mo. App. filed Sept. 17, 1915. Method of forming foil condenser terminals integral with the foil itself.

1,248,834. Automatic Trunking System; Edward D. Fales, La Grange, Ill. App. filed May 17, 1909. Improvements.

1,248,840. Ignition System; Valere A. Fynn, St. Louis, Mo. App. filed April 13, 1914. Battery ignition system.

1,249,027. Switch; John F. Cavanagh, Meriden, Conn. App. filed Oct. 4, 1916. For automobiles.

1,249,032. Method of Metering Telephone Traffic; Edward E. Clement, Washington, D. C. App. filed Feb. 23, 1905. Methods of registering messages and their duration.

1,249,036. Telephone System; Hiram D. Currier, Chicago, Ill. App. filed Oct. 1, 1913. Simplified arrangement of control circuits in connection with an operator's link circuit.

1,249,043. Limit-Switch Mechanism; William N. Dickinson, Brooklyn, N. Y. App. filed June 17, 1916. For elevators, dumbwaiters or similar apparatus.

1,249,053. Wire-Assembling Machine; Charles R. Evans, Akron, Ohio. App. filed March 12, 1917. Improvements in the feeding mechanism.

1,249,055. Pull-Switch Indicator; Gilbert W. Goodridge, Bridgeport, Conn. App. filed April 9, 1914. Improvements.

1,249,068. Push-Button; John Gramm, New York, N. Y. App. filed Dec. 14, 1916. Bell-ringing circuits.

1,249,083. Telegraphy; Ernest S. Heurtley, Oxford, Eng. App. filed June 24, 1916. Improved method of transmitting more than one message or impulse at the same time and in the same direction over one conductor and selecting out these messages or impulses to separate instruments at the distant end.

1,249,117. Pull-Chain Switch; Charles J. Klein, Milwaukee, Wis. App. filed Sept. 16, 1911. Having a quick break or quick make-and-break action.

1,249,135. Electrical System; Leon J. Le Pontois, Lakewood, Ohio. App. filed Dec. 7, 1910. Useful as a combined lighting and ignition system.

1,249,145. Machine-Switching Telephone Exchange System; Alben E. Lundell, New York, N. Y. App. filed Aug. 22, 1916. Improvements.

1,249,146. Telephone Exchange System; Alben E. Lundell, New York, N. Y. App. filed Dec. 2, 1916. Improvement in the circuits and control of selective signaling apparatus of party lines in an automatic telephone system.

1,249,152. Magneto Construction; Samuel C. McKeown, Sumter, S. C. App. filed Dec. 20, 1913. Various parts are rigidly held in operative relation to each other without the use of screws, rivets or other means.

1,249,154. Electric Switch; James L. McQuarrie, Montclair, N. J. App. filed Sept. 22, 1916. Improvements.

1,249,155. Electric Switch; James L. McQuarrie, Montclair, N. J. App. filed Sept. 22, 1916. For use in automatic and semi-automatic telephone systems.

1,249,157. Contact Interrupter for the Electromagnetic Production of Musical Sounds; Alcide H. Maitre and Victor H. G. Martin, Rouen, France. App. filed March 27, 1914. Improved.

1,249,159. Two-Wire Automatic Telephone System; Talbot G. Martin, Chicago, Ill. App. filed March 21, 1908. Provides a two-wire system in which automatic party-line service can be given the subscriber thereof.

1,249,162. Signaling System; Carl F. Mead, Cleveland, Ohio. App. filed Sept. 16, 1912. For offices, factories and banks.

1,249,223. Battery Changer; Arthur P. Smith, Portland, Me. App. filed April 17, 1916. For intermittently inserting sets of batteries into a circuit, with the resulting increase of the life of the batteries.

1,249,229. Direction Signal for Automobiles; Joseph C. Snow, Brockton, Mass. App. filed Aug. 16, 1916. Improvements.

1,249,236. Electric Vibrator; Rude Stockinger, Manitowoc, Wis. App. filed May 3, 1917. For vibrating pattern plates disposed in molds.

1,249,245. Electric Switch; John W. Teare, Kiowa, Tex. App. filed Feb. 3, 1917. For use in connection with telephones.

1,249,247. Attachment Plug; George B. Thomas, Bridgeport, Conn. App. filed Sept. 9, 1916. Jack-blade type.

1,249,268. Storage Battery; Theodore A. Willard, Cleveland, Ohio. App. filed Dec. 21, 1914. Means for preventing a high rise in temperature by providing for very rapid dissipation of heat.

1,249,274. Means for Fire Control for Dirigible Devices; Edward F. Chandler, Woodhaven, N. Y. App. filed Jan. 12, 1915. For accurately drecting the course of torpedoes.

1,249,285. Electric Water Heater; Milton H. Shoenberg, San Francisco, Cal. App. filed Aug. 27, 1917. Heating chamber which is entirely inclosed by electrodes through which an electrolytic action may be obtained without decomposition of the electrodes.

1,249,286. Electroplating Apparatus; Elmer B. Stone, New Britain, Conn. App. filed Nov. 7, 1916. Provides means by which hollow articles may be advantageously treated.

(Issued Dec. 11, 1917)

1,249,313. Switch Box; John C. Boyton and Oris H. Nickerson, Cleveland, Ohio. App. filed Jan. 23, 1914. Removable sides.

1,249,359. Section Insulator; George B. Ely, Elkhart, Ind. App. filed March 13, 1916. Overhead construction for electric trolley lines.

1,249,386. Telephone-Switch Mechanism for Preventing Cord Twist; Hans Hansen, Kansas City, Mo. App. filed March 12, 1917. Located in the base of a desk telephone instrument.

1,249,389. Electric Fixture; Gustav A. Harter, Chicago, Ill. App. filed Aug. 18, 1913. Shades may be separately adjusted.

1,249,398. Sound-Reproducing Machine; William F. Hitchcock and Joseph F. Hitchcock, Rochester, N. Y. App. filed Nov. 27, 1914. Electrically driven.

1,249,409. Sound-Transmitting Apparatus; Alva D. Jones, Philadelphia, Pa. App. filed March 2, 1914. Talking machine.

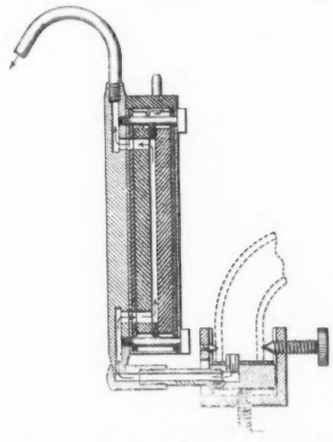
1,249,414. Process of Making Talking-Machine Records; John Kaiser, New York, N. Y. App. filed May 31, 1917. Involving the production of an original record by electrolysis.

1,249,429. Multiple Lightning Arrester; Wilbur S. Lewis, Lakewood, Ohio. App. filed Feb. 16, 1916. Adapted to be used for protecting telephone and telegraph lines.

1,249,430. Test Clip; Wilbur S. Lewis, Cleveland, Ohio. App. filed Oct. 3, 1916. Improvements.

1,249,464. Laundry Appliance; Helen M. Nolen, Toledo, Ohio. App. filed July 7, 1916. Irons.

1,249,479. Electric Furnace for Producing Endothermic Gas Reactions; Richard Pfaehler, Charlotte, N. C., and Ingenuin Hechenbleikner, Great Falls, S. C. App. filed Aug. 26, 1913. Improvements.



1,249,285—Electric Water Heater

1,249,482. Radio Telegraphy and Telephony Receiver; Greenleaf Whittier Pickard, Amesbury, Mass. App. filed March 20, 1914. Improvements.

1,249,526. Electric Switch; William G. Shelton, New York, N. Y. App. filed Sept. 11, 1916. Means for starting an electric motor at higher than its normal running speed, whereby it instantly overcomes the inertia of the driven part.

1,249,530. Electromagnetic Ship's Log; Charles G. Smith, Cambridge, and Joseph Slepian, Boston, Mass. App. filed Dec. 20, 1915. Method of measuring the speed of a ship.

1,249,532. Electric Welding; Herbert M. Smith and William W. Stanley, Great Barrington, Mass. App. filed April 14, 1916. Improved method of welding together metallic sheet edges or parts, so as to obtain a better and more uniform weld.

1,249,570. Signaling System; Stanley S. A. Watkins, Mount Vernon, N. Y. App. filed Dec. 29, 1916. Telephone.

1,249,574. Electric Lamp; George E. Werner, Los Angeles, Cal. App. filed Sept. 26, 1916. For vehicles.

1,249,582. Telephone Exchange System; Joseph L. Wright, Cleveland, Ohio. App. filed Nov. 11, 1912. Semi-automatic.

1,249,732. Magneto; Louis J. Flint, Detroit, Mich. App. filed Sept. 28, 1914. Improvements.

1,249,842. Fire and Temperature Alarm; George L. Smith, London, Eng. App. filed Dec. 4, 1915. Improvements.

1,249,849. Telephone Mouthpiece; Louis Steinberger, Brooklyn, N. Y. App. filed Feb. 10, 1912. Sanitation is improved.

Electrical World

F. M. FEIKER, Editorial Director W. H. ONKEN, JR., Editor

New York, December 29, 1917

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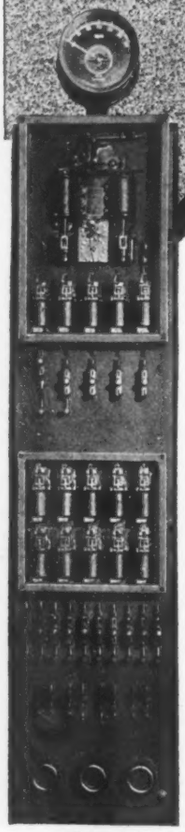

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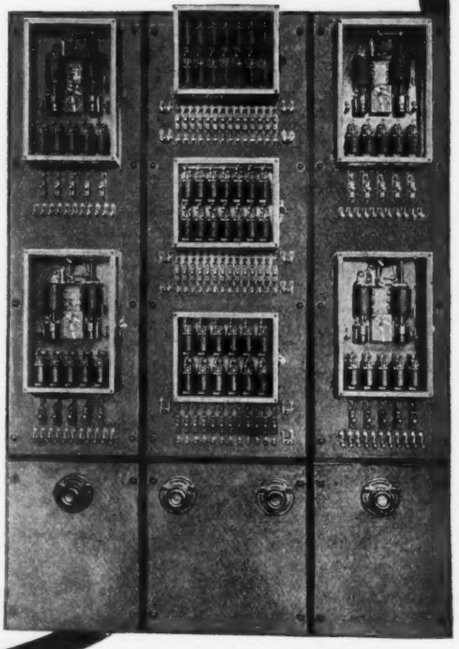
2. The maintenance of constant voltage at the end of transmission lines by the control of synchronous condensers or synchronous boosters.
3. The control of booster converters.
4. The control by special regulators of synchronous condensers applied to local network, or distributing systems, for voltage regulation and power factor correction.

The Voltage Regulators are arranged in suitable cases for bracket, panel or pedestal mounting.—The use of master relays permits the construction of regulators with as many as 60 rheostat-shunting relays. Any size regulator can be designed to be mounted on one or more 16 in. panels.

For full description send for Leaflet No. 3822-A



Special 40-Relay Regulator for Laurentide Power Co.

W WESTINGHOUSE ELECTRIC

Westinghouse Electric & Manufacturing Company

East Pittsburgh, Pa.

Atlanta, Ga.
Baltimore, Md.
Birmingham, Ala.
Bluefield, W. Va.
Boston, Mass.
Buffalo, N. Y.
Butte, Mont.
Charleston, W. Va.
Charlotte, N. C.
Chattanooga, Tenn.
Chicago, Ill.
Cincinnati, Ohio
Cleveland, Ohio
Columbus, Ohio
*Dallas, Texas
Dayton, Ohio
Denver, Colo.
Des Moines, Ia.
Detroit, Mich.
Duluth, Minn.
*El Paso, Texas
Houston, Texas
Indianapolis, Ind.
Joplin, Mo.
Kansas City, Mo.
Louisville, Ky.
Los Angeles, Cal.
Memphis, Tenn.
Milwaukee, Wis.
Minneapolis, Minn.
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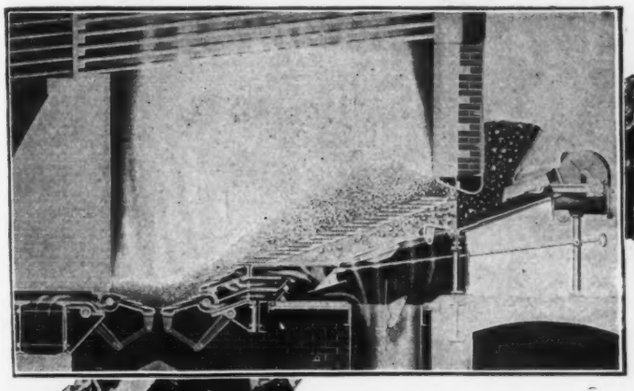
Pittsburgh, Pa.
Portland, Ore.
Rochester, N. Y.
St. Louis, Mo.
Salt Lake City, Utah
San Francisco, Cal.
Seattle, Wash.
Syracuse, N. Y.
Toledo, Ohio
Washington, D. C.
Wilkes-Barre, Pa.

*W. E. & M. Co. of Texas

Westinghouse

Underfeed Stokers



The Westinghouse Underfeed Stoker burns a GREAT VARIETY of fuels SATISFACTORILY—ranging from the high-volatile Eastern to the high-ash Western coals and lignite.

This stoker is operating **satisfactorily** as far West as Wyoming, as far East as Massachusetts, as far North as Minnesota and as far South as Louisiana,

If you are a Westerner, we ask you to personally investigate our Western Plants. If a Northerner, Easterner or Southerner, we ask again that you personally visit our installations in your territory.

We believe it will be more satisfactory for you to get the facts first-hand.

Write for a list of installations near you.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

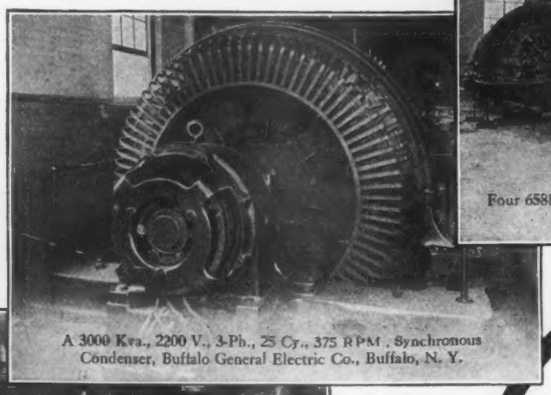
W
WESTINGHOUSE ELECTRIC

Westinghouse

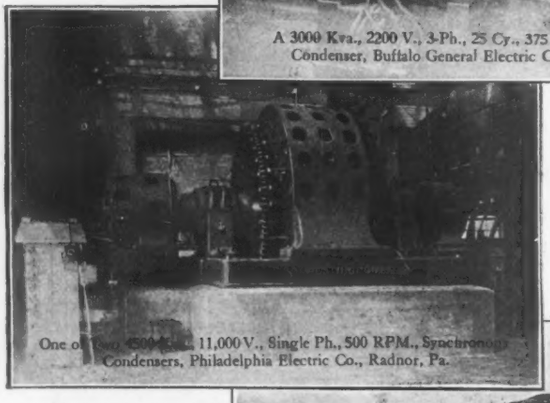
Synchronous Condensers

Capacities Ranging from 100 to 15,000 Kva.

Four 6588 Kva., 6600 V., 25 Cy., 375 RPM., Synchronous Condensers
Salmon River Power Co., Stillwater, N. Y.



A 3000 Kva., 2200 V., 3-Ph., 25 Cy., 375 RPM., Synchronous Condenser, Buffalo General Electric Co., Buffalo, N. Y.

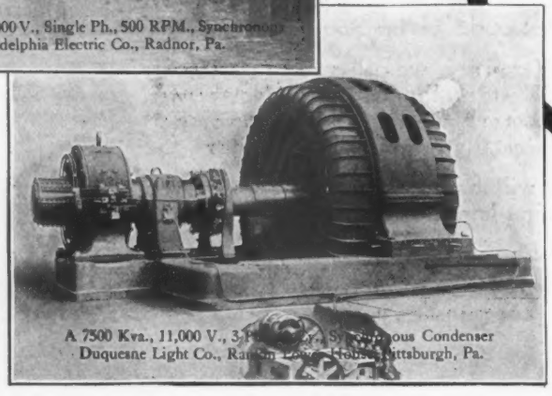


One of [illegible] 11,000 V., Single Ph., 500 RPM., Synchronous Condensers, Philadelphia Electric Co., Radnor, Pa.

We illustrate some Westinghouse Installations for power-factor correction.

Westinghouse Synchronous Condensers reduce losses and increase existing feeder-line outputs.

Our nearest office will give full particulars.



A 7500 Kva., 11,000 V., 3-Ph., [illegible] Synchronous Condenser
Duquesne Light Co., Ra[illegible] Station, Pittsburgh, Pa.

W
WESTINGHOUSE ELECTRIC

Westinghouse Electric & Manufacturing Company

East Pittsburgh, Pa.

Atlanta, Ga.	Charleston, W. Va.	*Dallas, Texas	*Houston, Texas	Milwaukee, Wis.	St. Louis, Mo.
Baltimore, Md.	Charlotte, N. C.	Dayton, Ohio	Indianapolis, Ind.	Minneapolis, Minn.	Salt Lake City, Utah
Birmingham, Ala.	Chattanooga, Tenn.	Denver, Colo.	Joplin, Mo.	New Orleans, La.	San Francisco, Cal.
Bluefield, W. Va.	Chicago, Ill.	Des Moines, Iowa	Kansas City, Mo.	New York, N. Y.	Seattle, Wash.
Boston, Mass.	Cincinnati, Ohio	Detroit, Mich.	Louisville, Ky.	Philadelphia, Pa.	Syracuse, N. Y.
Buffalo, N. Y.	Cleveland, Ohio	Duluth, Minn.	Los Angeles, Cal.	Pittsburgh, Pa.	Toledo, Ohio
Butte, Mont.	Columbus, Ohio	*El Paso, Texas	Memphis, Tenn.	Portland, Ore.	Washington, D. C.
				Rochester, N. Y.	Wilkes-Barre, Pa.

*W. E. & M. Co. of Texas

WESTINGHOUSE MAZDA C Street Series Lamps

IF there is one type of lamp in which quality and dependability are of greater importance than in others—that type is the street series lamp.

WESTINGHOUSE MAZDA STREET SERIES LAMPS have established an enviable reputation for satisfactory performance, and for confirmation of this we refer you to any Central Station who has ever used them. We would be glad to furnish the names of some.

Westinghouse Lamp Company
165 Broadway, New York

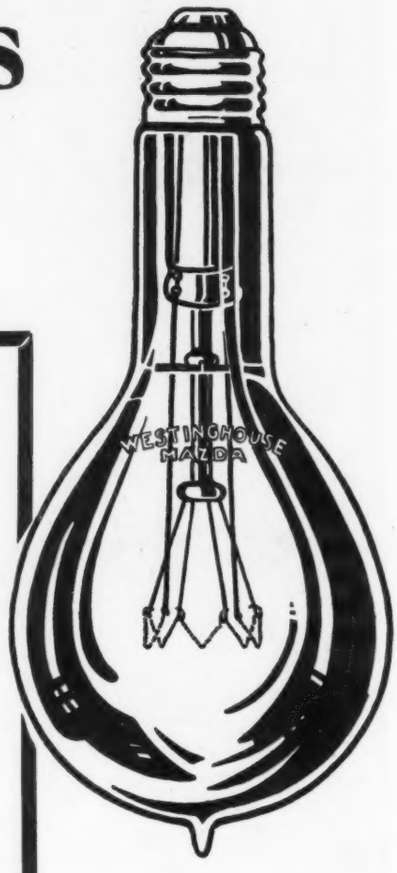
Sales Offices and Warehouses Throughout the Country

WESTINGHOUSE · LAMP COMPANY · TRADE MARK · U·S·A · W

WESTINGHOUSE · MAZDA LAMPS

GUARANTEED BY THE NAME

Announcement of New Prices



EFFECTIVE January 1st, 1918, the prices on practically all sizes and types of Westinghouse Mazda Lamps, Westinghouse Metallized Filament Lamps and McCandless-Westinghouse Miniature Lamps, will be changed.

Schedules showing the new prices are being distributed to Customers and Agents.

GUARANTEED BY THE NAME

Westinghouse Lamp Co.
165 Broadway, New York, N. Y.

Sales Offices and Warehouses Throughout the Country.

WESTINGHOUSE MAZDA LAMPS

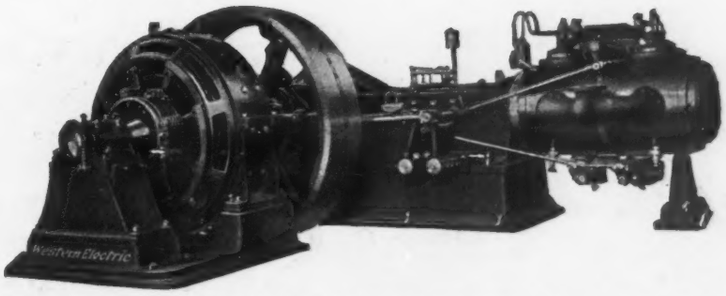
A type of Western Electric Induction Motor

Are You Looking for Immediate Delivery on Motors

We can help you with stocks held ready for shipment at our houses, some one of which (if not more than one) is near you. Motors for Alternating Current. Motors for Direct Current. For all commercial circuits and all commercial voltages.

Get Our Latest Bulletins on *Western Electric* Power Apparatus

Write our nearest house describing your power needs



A type of Western Electric direct current generator, direct connected

SAVE TIME AND FREIGHT

DYNAMOS-MOTORS WESTERN ELECTRIC COMPANY CABLE-TELEPHONES-SUPPLIES

TELEPHONE OUR NEAREST HOUSE

Western Electric Company
INCORPORATED

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"Over the top"

Big salaries await big men—know elec

Terrell Croft

Be guided in your study of electricity by an experienced Electrical Engineer of high professional standing.

Terrell Croft, author of seven of these volumes, stands without peer in his field. He rose from dynamo tender, through the ranks, to electrical engineer with the Westinghouse Company. He gained his experience with his sleeves rolled up. He gives it to you in books that are technically of the highest order, yet free from involved theory and complex mathematics. And in the excellence of the illustrations and printing, the flexibility and convenience of the thin paper, pocket-size volumes, and the richness of the morocco grained Karatol binding, they are fittingly dressed for this great achievement.

Don't dabble in electricity—be an expert through training, and earn an expert's salary. This is your chance to fit yourself for rapid advancement. The vast expansion of this great field is offering rich opportunities for the practical electrician who also knows the technical side of the industry. These eight books—seven of which were written by Terrell Croft, formerly with Westinghouse, will help you—at home, during your spare time to become a well-paid electrical expert.

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The New McGraw-Hill
Library of Practical Electricity

Easy Payments, $2 per month. Complete Course, 8 volumes only $16.

In electricity, above all else, you want up-to-date information. The new Library of Practical Electricity treats of electricity as it is practiced today. It is not merely a reference library with questions and answers, but a standard and authoritative course of study for both beginner and expert—as valuable to one as to the other, because it contains only actual working data which everyone can understand.

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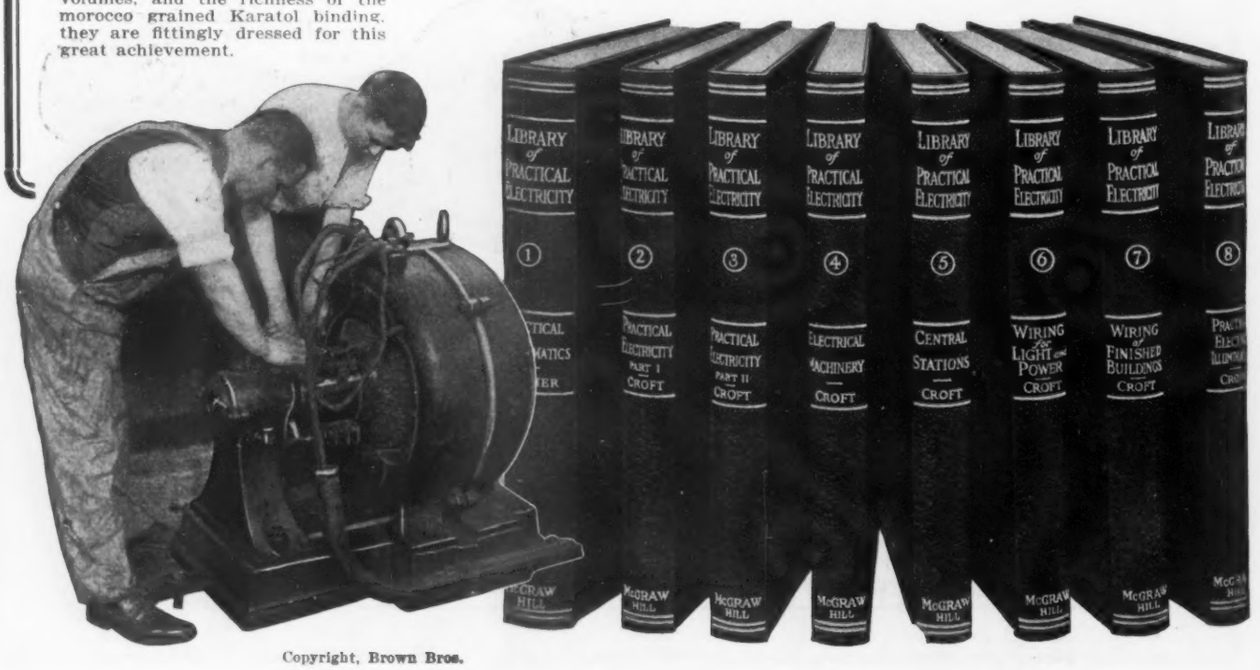
It is not a correspondence course—but a complete home study course, complete in itself, one that requires no correspondence instruction. Every one of the eight volumes is a self-teacher, constructed specially for self education. The information is all right before you. There is no time wasted in consulting others. The set contains a complete technical electrical education, which would probably cost you several hundred dollars if procured from any other source. However, you pay only $16 for the set complete, in small monthly installments.



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in electricity

tricity as the practical expert knows it

It is no longer necessary for you to depend upon time-worn amateurish and "technical" books written by theorists. You can now learn electricity as you would in actual practice, in a small fraction of the time, and in accordance with the methods employed by the highest paid practical electrical workers in America. You can learn all this at home, or you can carry in your pocket one or two volumes at a time to your work.

No amount of description can possibly outline to you the great importance of the Library of Practical Electricity in the electrical field of today.

When you see the books you will then know why every electrical student and every electrical worker in America needs them.

You must see the Library and run through its three thousand pages and glance at its hundreds of clearly drawn illustrations before you can begin to understand the meaning of this complete exposition of the practical side of electricity.

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No. 1.—Practical Mathematics.
Contains 620 pages—fully illustrated. Preliminary work and review; common and decimal fractions, short methods and checks; weights, measures, percentage, proportion, powers and roots, geometry, algebra and trigonometry.

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Contains 646 pages, 582 illustrations. Generation of energy; circuits, magnet windings, primary cells, storage batteries, generators, armature winding; voltage, direct-current, shunt and compound wound motors. Alternating currents; transformers, etc.

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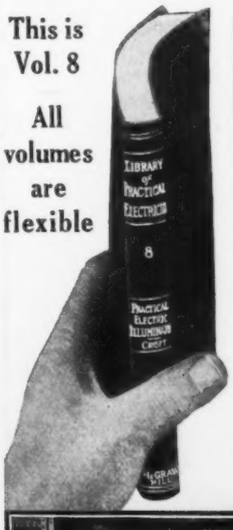
Contains 225 pages, 166 illustrations. Light, radiation, reflectors, lamps, principles of illumination design; interior and exterior illumination.

This is Vol. 8

All volumes are flexible



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Pay for the course as you go along. $2 per month for 8 months will give you a set of books which represents an achievement without parallel in technical literature. The terms are so easy that you can now easily afford a training which will prepare you in a short time to take a more responsible, better paid position.

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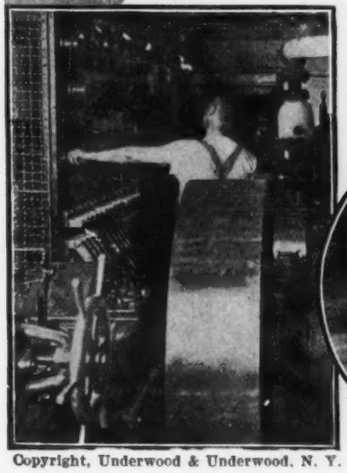
The coupon below is for your convenience in examining these practical books. It obligates you in no way; on the other hand it may easily mean permanent success for you in the well-paid field of practical electricity. You will want to see with your own eyes just how electricity is taught from the standpoint of the highly paid expert. You have wondered if it would ever be possible for you, with your probably limited means, to have the advice and guidance of a real electrical engineer, one who had actually served with one of the great electrical companies of America. Terrell Croft, author of seven of the books in the set, climbed from the ranks to electrical engineer for the Westinghouse Company. The author of a book means everything to you. He means that you shall be correctly taught the principles of electricity, or that your time shall be entirely wasted. Decide on a man who gained his knowledge with his sleeves rolled up. Decide now to see the Library of Practical Electricity. Just fill out the coupon. We trust you with the books. Pay $2 per month for eight months if you are satisfied. Send them back at our expense if you are not. Examination costs nothing. Act now.



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Gentlemen:

Please send me the Library of Practical Electricity (shipping charges prepaid) for 10 days' free examination. If satisfactory, I will send $2 in ten days and $2 per month until $16 has been paid. If not wanted I will write you for return shipping instructions.

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IMPORTANT

Announcing

change in Prices of practically all Edison Mazda, Edison Gem and Edison Mazda Miniature Lamps.

New Prices Effective
January 1, 1918

Price Schedules

containing New Prices are being distributed promptly to all Purchasers and Agents of Edison Lamps.

EDISON LAMP WORKS

OF GENERAL ELECTRIC COMPANY

Harrison, N. J.

His Only Rival
EDISON MAZDA LAMPS

Put Your Resistance Problems Up to

Resistance Experts

All circuits have resistances in some form.

Engineers adapt in circuit values of resistances with which they are familiar.

We offer resistances in values and sizes never made nor offered by other manufacturers.

Are these values known to you?

Tell us your problems and we, as experts and specialists, will work them out for you—whether you require a fixed resistance unit or variable control.

Our engineering service, our immense number of stock plates, our quarter century of experience, enable us to select for you the best adapted and least expensive control to meet your needs.

Ward Leonard Electric Company

Mount Vernon, New York

Morse Engineering Co., St. Louis
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The Walter P. Ambos Co., Cleveland
Westburg Engineering Co., Chicago
Wm. M. Tompkins, Philadelphia
Sperry & Bittner, Pittsburgh
Electrical Specialties Co., Detroit

Irvington Insulating Materials

Black Varnished Cambric
Yellow Varnished Cambric
Black Bias Tape
Yellow Bias Tape
Oiled Silks
Oiled Papers
Black and Yellow Insulating Varnishes

FOR QUALITY Specify Irvington Insulating Materials.
PROMPT DELIVERIES Assured.

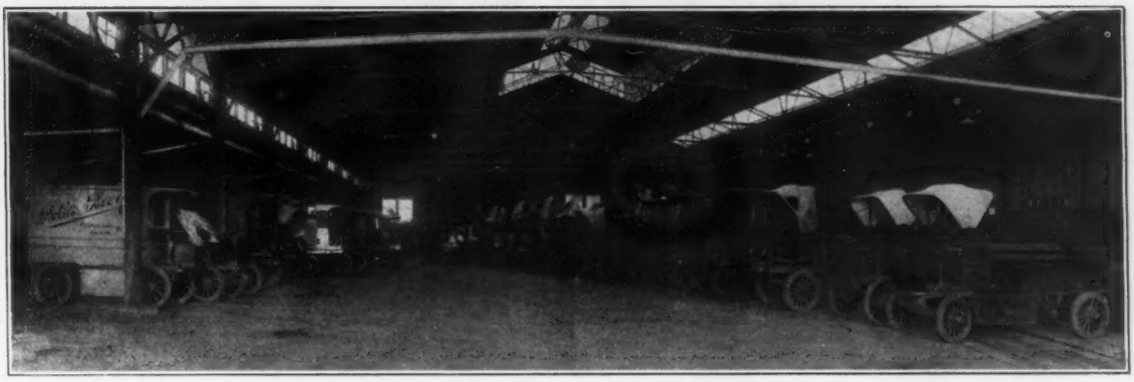
WRITE US for Prices, Samples and Data.
CONSULT US regarding your special Insulation requirements.

IRVINGTON VARNISH & INSULATOR CO.
Irvington, New Jersey.

The 4 "Exide" Batteries

"Exide", "Hycap-Exide", "Thin-Exide", "Ironclad-Exide"

for the Electric Commercial Car



The large electric fleet of Poth's Brewery, Philadelphia, equipped with Exide Batteries

The above photograph is but one of many instances when a large user of electric motor vehicles, after experimenting with various makes of batteries, has concentrated on those made by The Electric Storage Battery Company.

In every sort of service in which the electric truck, or electric pleasure car, has been used, "Exide" Batteries have demonstrated time after time their consistent superiority.

Because of the long experience in storage battery making that is built into them; because of their "giant" construction and many exclusive features, they give a service that is powerful, dependable and long lived.

Batteries manufactured by this Company Are Used:

Almost exclusively by Large Central Lighting and Power Companies.

By the Telephone and Telegraph Companies and for Wireless.

For Mine Locomotives, Railway Car Lighting, Switch and Signal Service, Battery Street Cars.

For Electric Vehicles and Industrial Trucks.

For Automobile Starting and Lighting.

THE ELECTRIC STORAGE BATTERY CO.

The oldest and largest manufacturer of Storage Batteries in this country

1888 PHILADELPHIA, PA. 1917

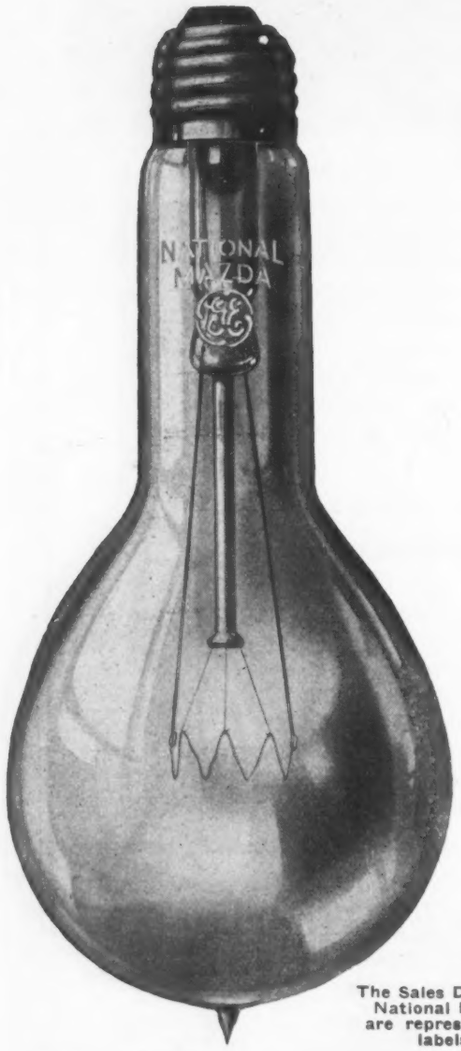
New York	Chicago	Cleveland	Rochester	Minneapolis
Washington	Denver	Boston	St. Louis	Atlanta
Pittsburgh	Kansas City	Detroit	San Francisco	Toronto

NATIONAL LAMP WORKS

Announcement

To Agents and Purchasers of

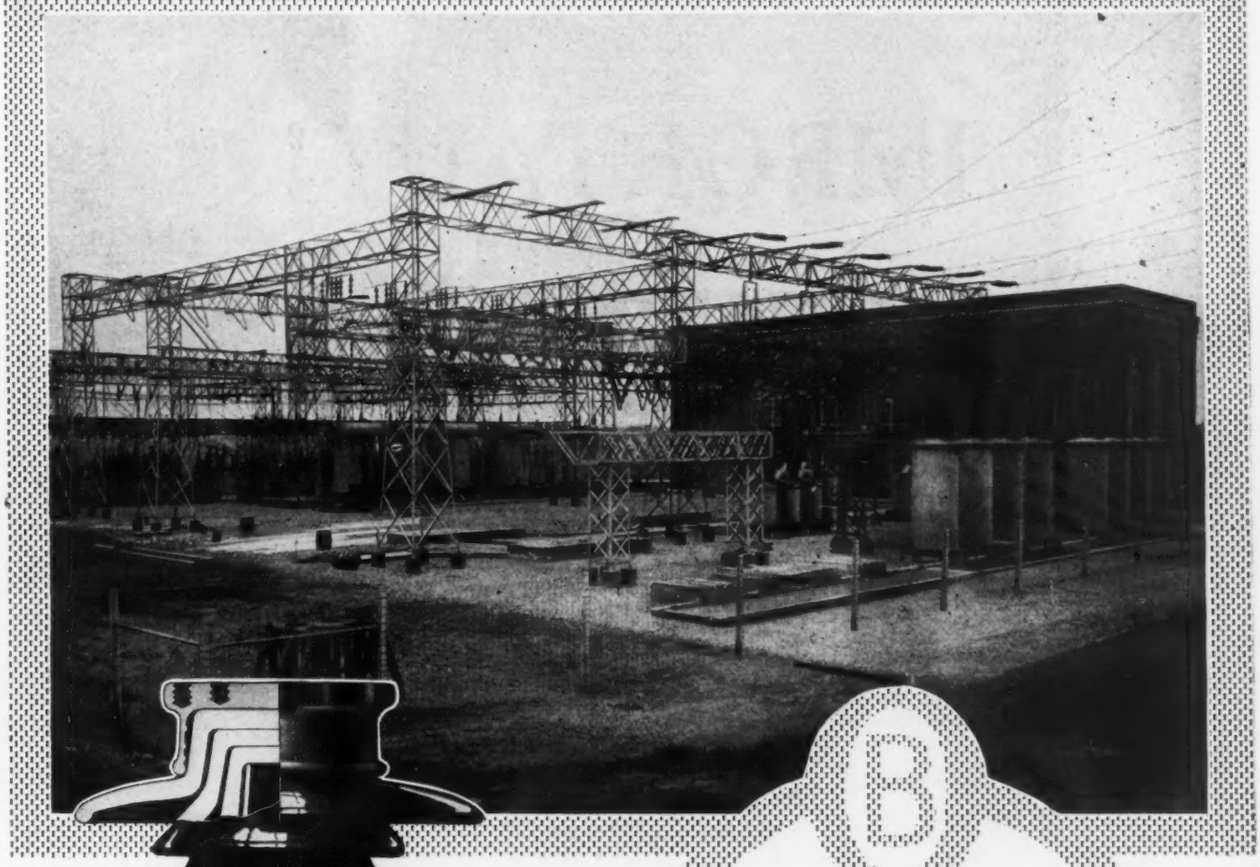
NATIONAL MAZDA LAMPS



Prices of large national Mazda and Gem lamps and Mazda Miniature Lamps will be changed beginning January 1st, 1918. Schedules detailing these new prices are now available and are being distributed promptly to all purchasers and agents of these Lamps. Let us know if you have not yet received yours.

NATIONAL LAMP WORKS
OF GENERAL ELECTRIC CO.
NELA PARK CLEVELAND

The Sales Divisions of the National Lamp Works are represented by the labels below



B

A Problem and Its Answer

The problem was the insulation of these outdoor switches. There were heavy mechanical stresses. The service was severe and most important.

The answer was the "heavy duty" insulator illustrated at the left. It had proved its fitness for such conditions elsewhere.

The insulator as shown is 44 inches overall, ultimate bending movement 60,000 inch pounds.

It can be supplied in 1, 2 or 3 elements, as desired.

Put your insulation puzzles up to O-B Engineers.

The Ohio Brass Co.
Mansfield, Ohio

IMPORTANT!

Schedules

Showing the New Prices of

FRANKLIN MAZDA *and* GEM LAMPS

are now being distributed to all customers and agents.

These Schedules Take Effect

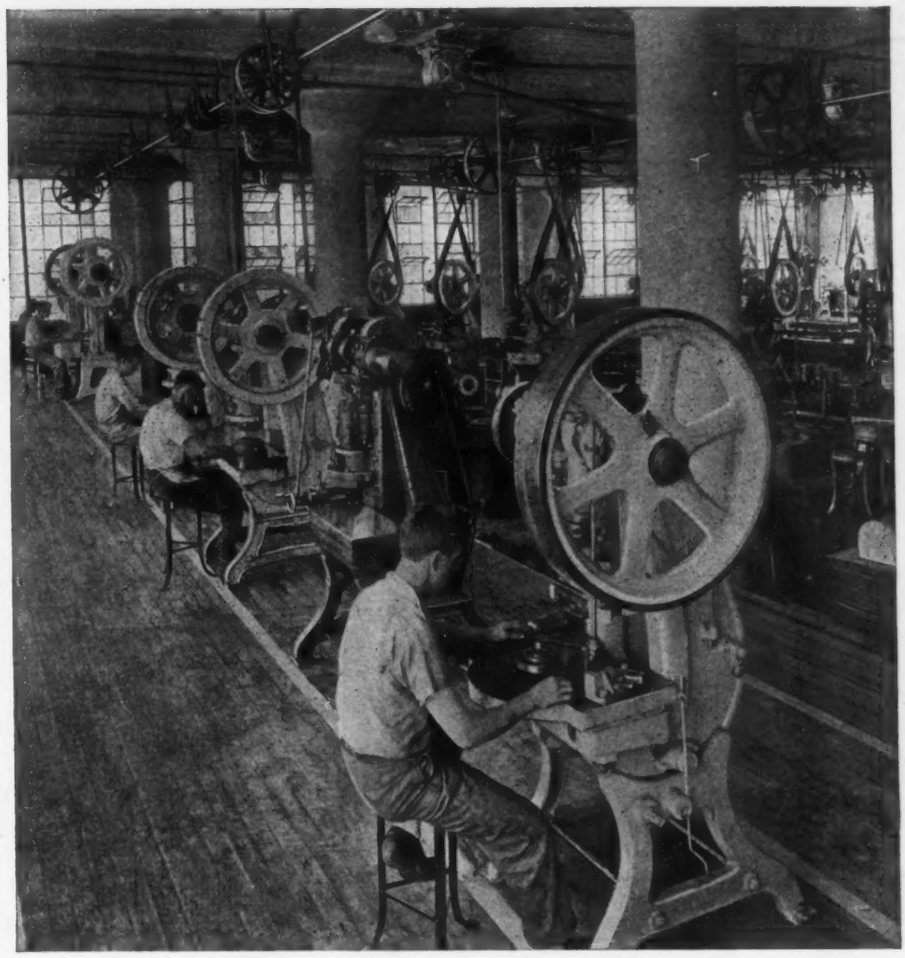
January 1st, 1918

Have you got yours?

If not, get in touch with us at once.

The Franklin Electric Manufacturing Co.

Hartford, Connecticut



Wagner motor, driving notching and punch presses

Wagner, Quality

Motors Are Thrifty Motors

But you won't find the saving in first cost. The thrifty man knows that it is the total, which is first cost, plus maintenance, plus operation, that tells the story.

You will pay for service one way or another. Better pay in first cost. That is the most economical way.

Provide yourself with Quality motors and you have eliminated chance. It is the Quality in Wagner, Quality Motors that protects you, your customer, your workmen and your machinery. If you are a motor user or contemplate the use of motors, Bulletins 1104 and 1114 will prove interesting and probably valuable to you.

Wagner Electric Manufacturing Company,
Saint Louis, Missouri

564

It's Practically Impossible for You to Buy a Defective Peirce Presteel Bracket

No. 231—Extra wire bracket

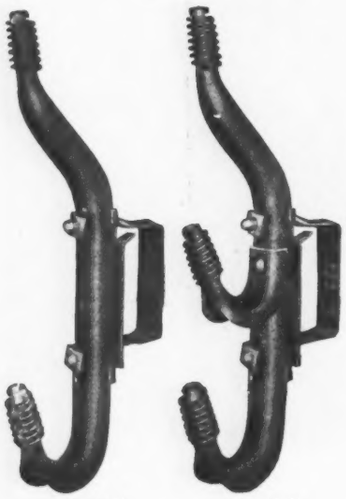
Because if there is the slightest flaw in the steel used in making Peirce Presteel Brackets, the defective metal will break in our forming dies. The Peirce Presteel method of manufacture automatically insures you against defective line hardware.

Cross-arms last longer when Peirce Presteel Brackets are used because most of our brackets *clamp around* the arms. No splitting, no holes for rot to creep in and the brackets won't pull off the arms.

Temperature variations don't break insulators that are held on Peirce spring threads because there are no large bodies of metal to expand. Insulators, though they have defective pin holes, can't lock themselves on Presteel brackets. The new method of fastening the spring thread makes the insulators fit snugly.

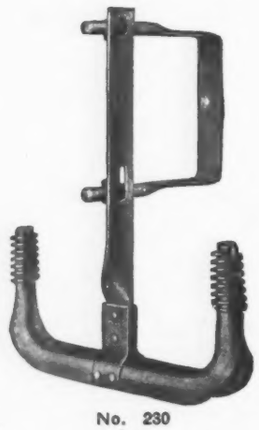
You can, therefore, see the logic of our statement when we say that

Peirce Presteel Brackets are the Best Kind of Line Insurance



No. 217 Cross-Arm Spreader Brackets No. 317

There is a Peirce Presteel Bracket for every need. Numbers 217 and 317 cross-arm spreader brackets are made to fit any standard size of cross-arm. The spacing between the top and lower points is 13 in. The middle point of No. 317 is 7½ in. below the top point, so you can run service wires across the arm with good clearance from the line wires.



No. 230

The "Cow Horn" (No. 231) is the type of break-arm in general use as a circuit breaker on series lighting circuits. It, also, fits any standard cross-arm.

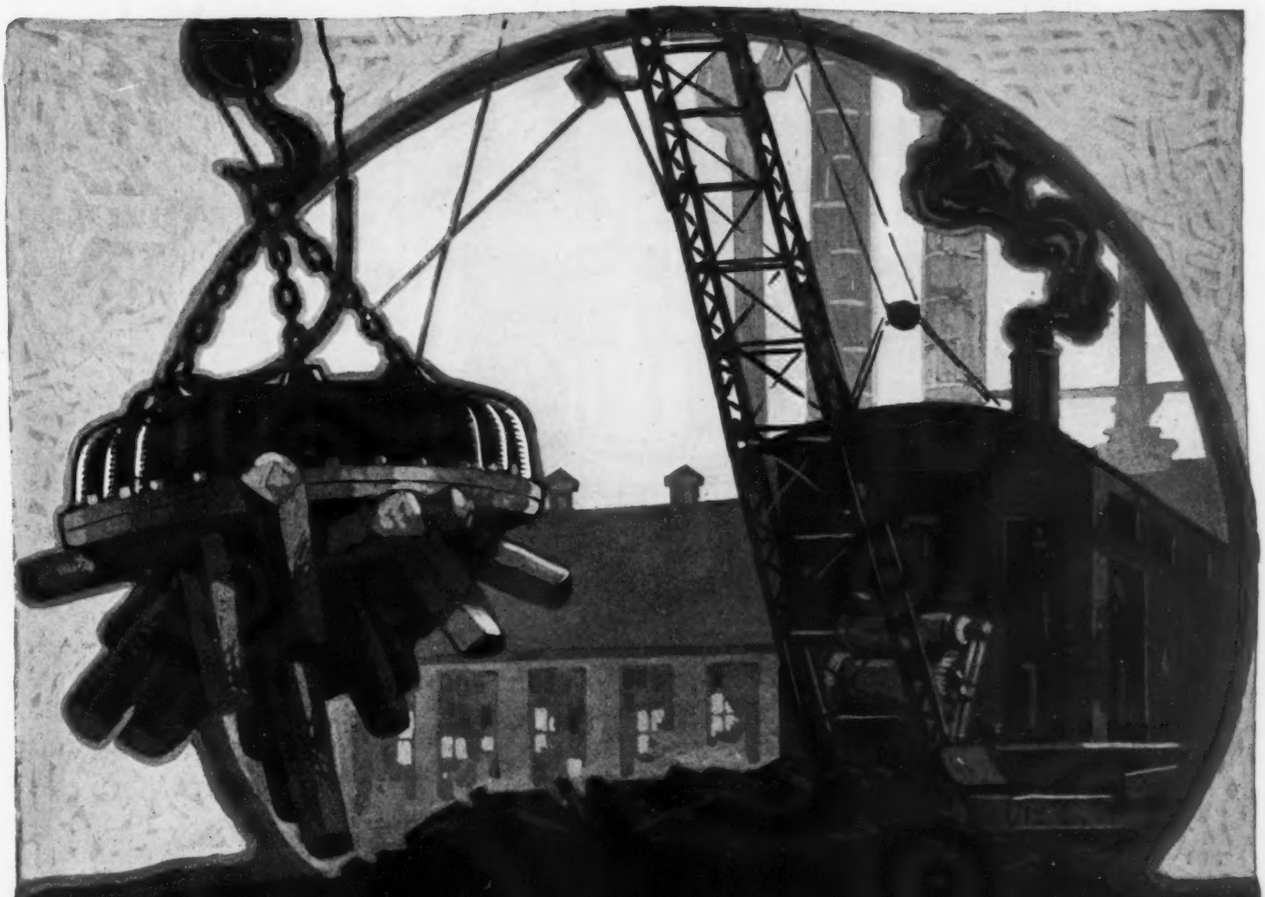
No. 230 will save you the cost of a cross-arm by carrying two extra wires under an arm already filled or will act as a break-arm.

Have you received a copy of supplementary Bulletin No. 1? Better get it—it tells a few new stories.

When you write an order for Peirce Presteel racks and backets you are writing the best kind of a line insurance policy.

HUBBARD & COMPANY, PITTSBURGH

The Hardware MAKES the Line—Hubbard makes THE Hardware



C-H LIFTING MAGNET

Their Increased Capacities A Boon In These Times

With the forced productions of all plants in the iron and steel, and allied industries, the increased lifting capacity of C-H Magnets has indeed been a boon.

It means that:

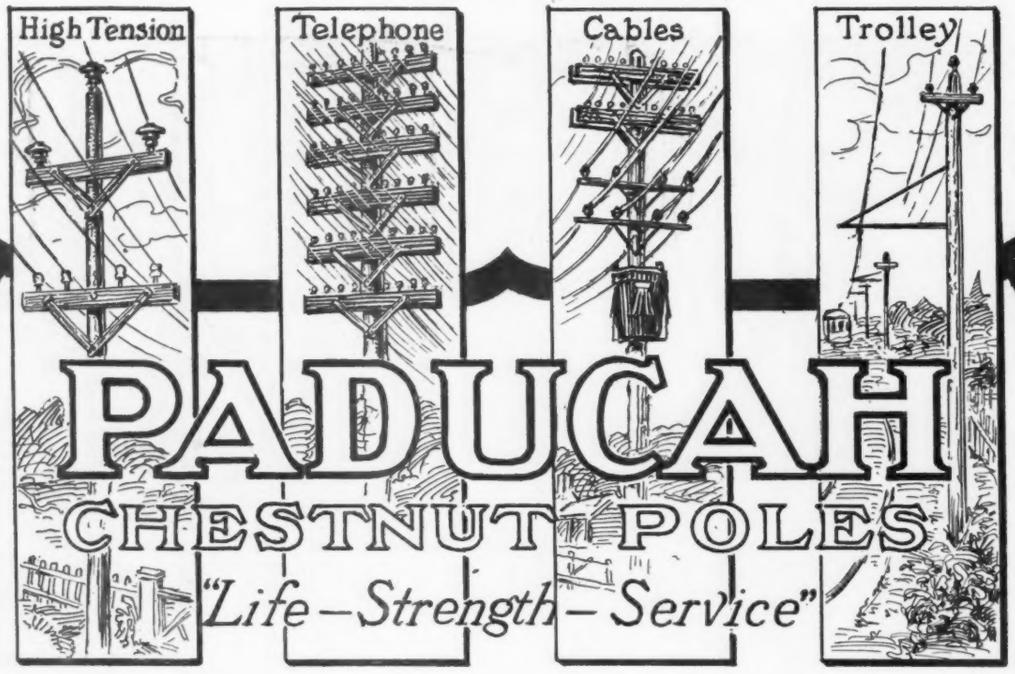
Fewer magnets handle the same material;
Same number handle from 20 to 50% more;
Fewer trips for same quantity,—thus greater speed.

In view of present conditions, labor shortage, inclement weather, the need for more speed, you,—better than we, perhaps,—realize the advantage of lifting magnets and of the larger capacities of C-H Magnets.

The office nearest you will gladly mail a copy of Bulletin 12.

The Cutler-Hammer Mfg. Co., Magnet and Clutch Dept., Milwaukee

New York, Pittsburgh, Chicago, Boston, Cleveland, Philadelphia, Cincinnati, San Francisco, Los Angeles, Seattle



PADUCAH
CHESTNUT POLES
"Life—Strength—Service"

Paducah Chestnut Poles will shield your line in any kind or condition of service.

Chestnut is the ideal timber for poles—wherever or however they may be used—for poles it has no equal.

Paducah Chestnut Poles have life, strength and durability. Carefully selected, they make sightly lines. Strong, they withstand sleet and storm as no other poles will. Durable, mostly heartwood, they resist rot.

Furthermore we will furnish them gained, bored, roofed, and treated—much better and cheaper than your lineman can do it.

Write for full information.

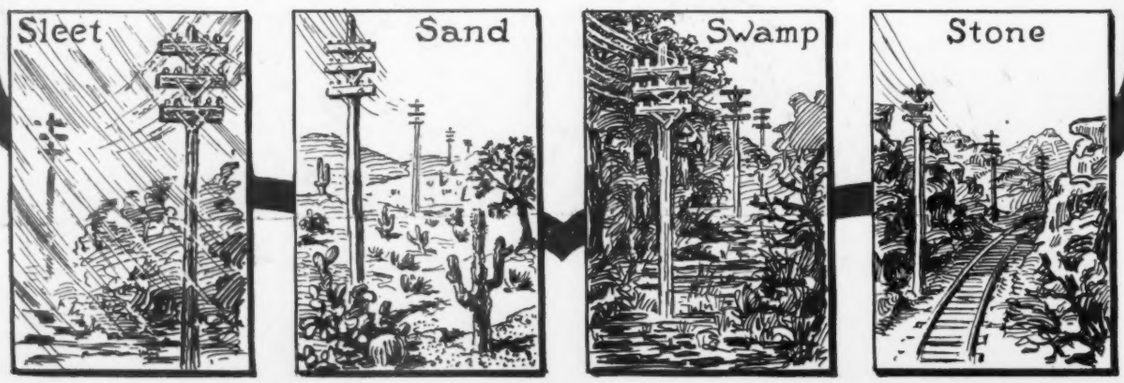
PADUCAH POLE & TIMBER CO.

JOHN L. FAY, SALES M'G'R.

407 City Nat'l Bank Bldg.,
Paducah, Ky.

Producers of chestnut poles, long-leaf yellow pine and cypress cross arms, locust pins, oak pins, piling, bridge timbers, posts and lumber.

Yards: Paducah, Dividing Ridge, Bonnieville, Munfordville, Ky.; Metropolis, Ill.; Mansfield, Tenn.



CONDIT ELECTRICAL MFG. COMPANY, SOUTH BOSTON, MASS.

TYPE D-13
OIL SWITCHES AND CIRCUIT BREAKERS

Application

D-13 oil switches and circuit breakers are used for controlling and protecting generators, feeder circuits, transformer banks, etc. Their sturdy construction, high factor of insulation, and ability to interrupt large amounts of energy, makes them highly desirable for controlling and protecting apparatus and circuits where uninterrupted service is of extreme importance.

CONDIT D-13 oil switches and circuit breakers are made in single, two, three, and four poles, for manual remote control or electrical operation. They are furnished in 300, 500, and 900 ampere capacity for pressures of 12,000 volts or less, and for capacities of 200 and 300 amperes where the pressure does not exceed 25,000 volts.

The D-13 oil switch and circuit breaker is adapted for flat surface mounting on either wall or in cells, or it may be mounted on pipe frame structures.

The design of the switch structure and operating mechanism is such as to afford the usual mounting arrangements met with in standard practice.

Construction

The face plates are neat and well finished. The handles are substantial and of good appearance, and are so arranged that they drop automatically to the open position when the circuit breaker opens, thus affording visual indication of the position of the movable contact members within the tank.

All automatic forms may be provided with **undervoltage, shunt trip, and time-limit attachments. Auxiliary switches** of the circuit-opening or circuit-closing type may also be utilized in connection with either the non-automatic or automatic form.

All automatic type D-13 overload circuit breakers have their trip coils and calibration adjustments on the front of the switchboard, and the mechanism is arranged to prevent the operator from holding the switch closed during an overload or short circuit.

Some of the important features which characterize CONDIT D-13 oil switches and circuit breakers are the efficient laminated brush, the reversible and easily renewable auxiliary arcing tips, the self-aligning, sure-seating action between the movable contact members and the stationary contact members, the rugged **"tank per pole"** construction, high head of oil over break, large expansion chamber, and the strong spring action inherent in the CONDIT brushes, which facilitates rapid acceleration of the movable contact members on the initial opening of the circuit.

Installation

The Condit Electrical Mfg. Company does not recommend the mounting of oil switches or circuit breakers directly on the panel or panel frame for the control of circuits whose potential exceeds 2500 volts, or where the ampere capacity exceeds 800 amperes, in which case remote control switches and circuit breakers should be used.

The Condit Electrical Mfg. Company does not recommend the installation of oil switches or circuit breakers in places where the contacts will be subjected continuously to a temperature in excess of 70° C.

Such conditions call for special apparatus and should be referred to the factory.

It is also recommended that all switchboard apparatus and accessories be grounded in accordance with the rules of the National Board of Fire Underwriters.

2

CONDIT ELECTRICAL MFG. COMPANY, SOUTH BOSTON, MASS.

Type D-13 Oil Switch and Circuit Breaker

Mounting

Flat surface (for wall or cell mounting) or pipe frame mounting, manually operated remote control and electrically operated, 15,000 volts or less where the current does not exceed 800 amperes, and 25,000 volts or less where the current does not exceed 300 amperes. For standard ampere capacities, see Table No. 1, page 4.

Poles and Throw

Type D-13 oil switches and circuit breakers are furnished for single throw only. However, when **double-throw** service is desired this may be obtained by the use of two single-throw oil switches or circuit breakers equipped with suitable interlock.

D-13 oil switches and circuit breakers are furnished in single, two, three, and four poles, in all standard ampere capacities.

ELECTRICALLY OPERATED—REMOTE CONTROL CELL MOUNTING

Tripping

CONDIT type D-13 oil switches and circuit breakers may be tripped by current transformers or the various combinations of relays and transformers used in standard practice. (For current transformers, see Bulletin No. 413.)

Tripping coils for use with current transformers, without the use of relays, are designed for 5 amperes continuous carrying capacity, and are calibrated at 4, 5, 7, and 10 amperes. When time-limit attachments are provided the lowest tripping value is 5 amperes. **Tripping coils for use with circuit-opening relays** associated with current transformers are calibrated to trip at 3 amperes.

Tripping coils for use with circuit-closing relays may be furnished for either direct or alternating-current circuits up to and including 550 volts.

Many combinations of current transformers and trip coils are used to provide protection to meet the various requirements of service. Adequate overload protection may usually be obtained by the use of the following combinations:

Single-phase, two-wire systems, 2-pole circuit breaker with one trip coil and one current transformer.

Two-phase, four-wire systems, **without interconnection,** 4-pole circuit breaker with two trip coils and two current transformers.

Three-phase, three-wire systems, with **ungrounded neutral,** 3-pole circuit breaker with two trip coils and two current transformers.

Three-phase, three-wire systems, with **grounded neutral,** 3-pole circuit breaker with two trip coils and three current transformers.

Three-phase, four-wire systems, 4-pole circuit breaker with two trip coils and three current transformers.

3

Another Link in the CONDIT Chain of Electrical Protective Devices

Condit Electrical Mfg. Co., South Boston, Mass.

Manufacturers of Electrical Protective Devices

Akron, 323 Ohio Bldg.
Albany, 102 Hamilton St.
Birmingham, Ala., Brown-Marx Bldg.
Buffalo, 604 Electric Bldg.
Charlotte, N. C., Commercial Bank Bldg.
Chicago, 19 South Fifth Ave.
Cincinnati, 1309-10 Union Trust Bldg.
Cleveland, Ohio, 1417 Illuminating Bldg.
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Washington, D. C., Conduit Road & Elliott St., N. W.

Northern Electric Company LIMITED

Sole Distributor for the Dominion of Canada, Montreal, Halifax, Ottawa, Toronto, Winnipeg, Regina, Calgary, Vancouver.

CONDIT: *the Synonym of Safety in Electrical Protective Equipment*

ORANGEBURG FIBRE CONDUIT

For Big Jobs where Dependability is Vital

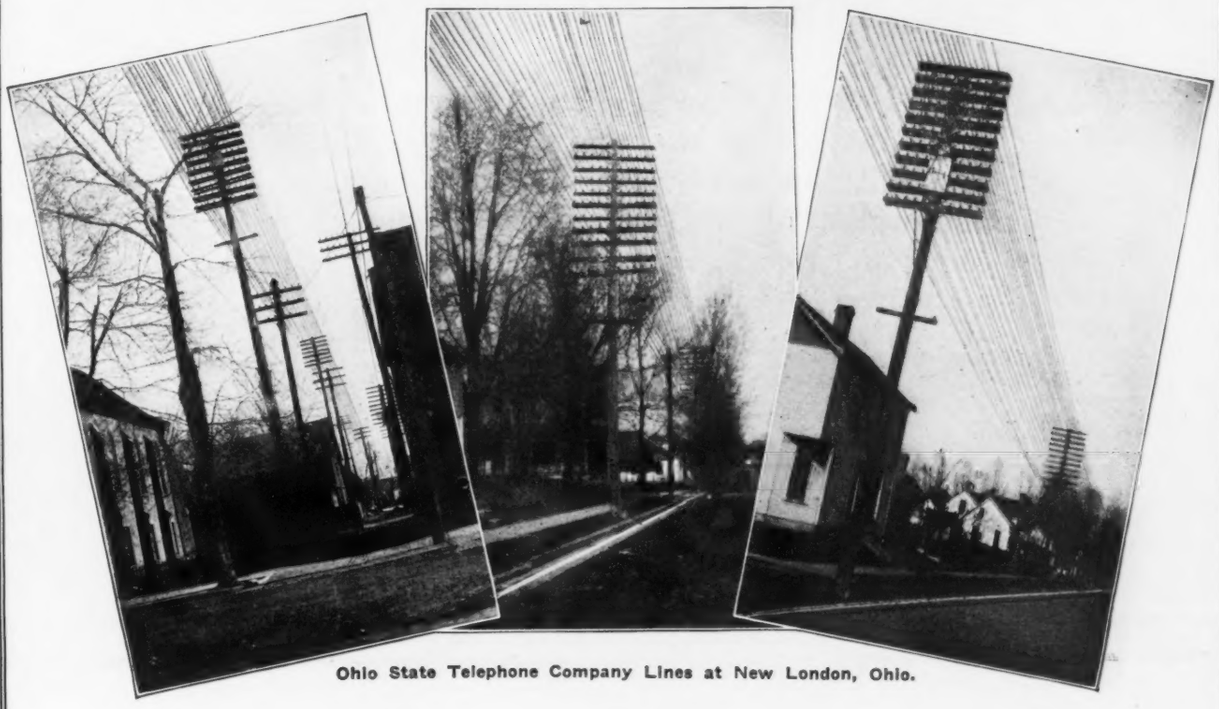
In no service application of conduit is *dependability* more vital than where used for the protection of railroad signal wires. Obviously a railroad company in placing an order for a great quantity of conduit for such service would surely specify a conduit of MAXIMUM dependability. The railroad making the above installation has purchased and placed in service over 1,500,000 feet of ORANGEBURG *Fibre Conduit*. See the point?

Get BOOK E.

THE FIBRE CONDUIT COMPANY
ORANGEBURG, N. Y.

New York Boston Chicago San Francisco

Northern White Cedar Poles



Ohio State Telephone Company Lines at New London, Ohio.

The lines illustrated here are from 15 to 20 years old.

Built of **Northern White Cedar Poles.**

Note the load they carry. Note the long service these poles have already given.

The Test That Tells Is the Test of Every Day Service.

Northern White Cedar Poles Make The Sturdy Attractive Line

Sold under the specifications of the Northern White Cedar Association which insure a high standard of quality.

Northern White Cedar Association

Lumber Exchange, Minneapolis

I-T-E
CIRCUIT BREAKERS

In times of stress like the present, figure up the cost of fuses and see if you do not reach the conclusion that the highest priced (and best) circuit breaker on the market is an economy rather than an expense. I-T-E Circuit Breakers are not sold on price, but on the basis of economies resulting from their use.

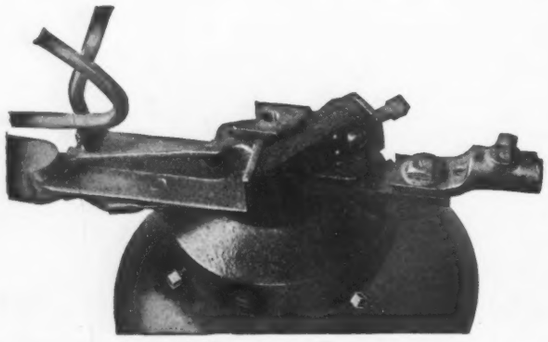
THE CUTTER CO., Philadelphia

Sleet and Winter Storms

Will not Freeze Up

Burke Horn Gap Switch

Sleet Hood completely covers Flexible Leaf Brush Contact, Toggle Joint in Arm gives Increased Reliability of Break.



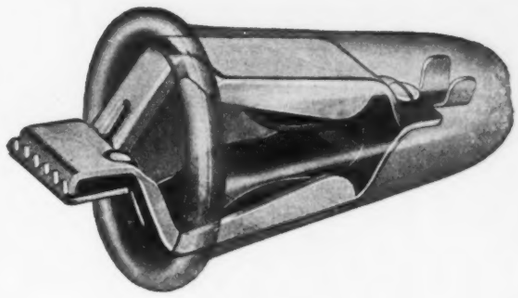
These two cuts show the main contact of the Burke Horn Gap Switch. The lower cut shows the contact closed—Sleet Hood removed.

Railway & Industrial Engineering Co.

Sales Office PITTSBURGH, PA. Works GREENSBURG, PA.

New York Representative, No. 2 Rector Street

Universal Test Clips



Time Savers in any electrical work requiring quick, temporary connections.

10-20-50 and 100 Ampere Sizes
Plain or INSULATED

Unexcelled for test sets, meters, transformer and motor test floors, shop test benches, college and commercial laboratories, motion picture projection work and storage battery charging.

Free sample—use company letterhead or state your position.

Write for a copy of our new catalog

R. S. MUELLER & CO.
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METROPOLITAN-PROTECTIVE-DEVICES-
JUST ANOTHER WAY TO SPELL ECONOMY

Consider These Advantages

Tamperproof and Foolproof Features
Safeguarding of Revenue
Continuity of Service
Prevention of Unauthorized Interference
Safety to Life
Elimination of Fire Hazard
Uniformity of Service Equipment
Accessibility for Repairs and Tests
Economy of Installation Expenses
Prevention of Overfusing

Now try them and be convinced

METROPOLITAN ENGINEERING COMPANY
Thirty-five Vestry Street—New York City
Canadian Representative: Metropolitan Engineering Co., Ltd.
90 Sherbourne Street Toronto, Canada

A Speed-Indicator for Permanent Mounting That Requires No Belt Gears or Electrical Connection

This is one of the Two UNIQUE AND EXCLUSIVE FEATURES of our

Frahm Vibration Tachometers

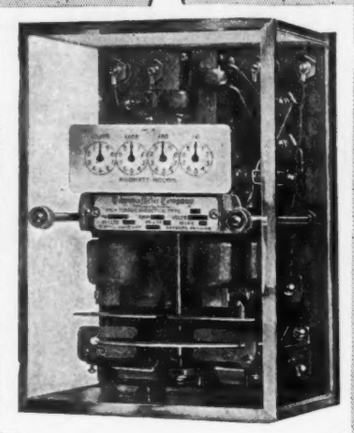
It is only necessary to screw the instrument (on a special bracket which we supply, if desired) to the base or other suitable part of a Steam Turbine, High-Speed Pump, Generator, Motor, etc., and that is "all there is to it!"

And the second *"feature"* is the *principle* upon which Frahm Tachometers operate; namely, a set of steel reeds (like a series of tuning forks) tuned in resonance with vibrations represented by the speed of the machine to which the instrument is fastened.

There are no springs or other delicate internal parts, and the high initial accuracy is sustained during long periods of continuous duty.

May we send you a copy of illustrated Catalog 856, which tells about Frahm Tachometers?

JAMES G. BIDDLE
1211-13 Arch Street, Philadelphia



Columbia
Type "C. S." Induction Watt-Hour Meters
Alternating Current Switchboard Model

The general appearance of the Columbia type "C.S." meter is most attractive, as will be seen from the illustration. The case is of heavy plate glass with beveled front. The base plate, coils and the like are dead black, discs are natural aluminum, and all parts capable of being plated are polished black nickel.

The case matches that of the Columbia direct current type "S.A." meter, which is of advantage where both A. C. and D. C. meters are to be mounted on the same switchboard.

Type "C.S." meters are furnished both for single and polyphase circuits and, with appropriate current and voltage transformers, for all capacities and voltages.

The mechanism is of the induction type, of course, and the excellent design results in a meter of high torque and high ratio of torque to weight—in other words, high efficiency. The combination in the one device of correct design, high quality materials, careful calibration and rigid inspection is assurance that any Columbia type "C.S." meter will do its work properly—and continuously—with a minimum of attention.

Bulletin No. 96 gives the details. Send for it.

Roller-Smith Company
Main Office and Export Dept.
233 Broadway, New York

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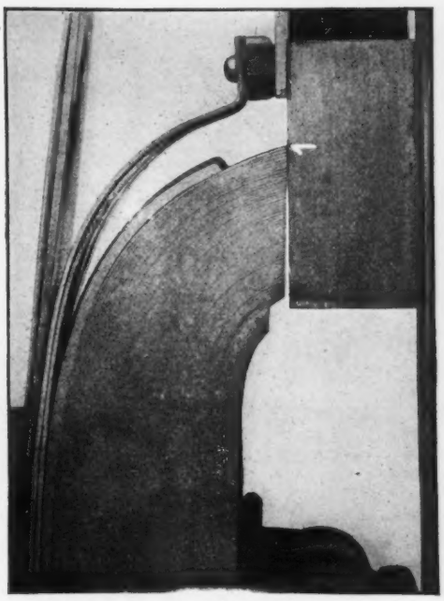
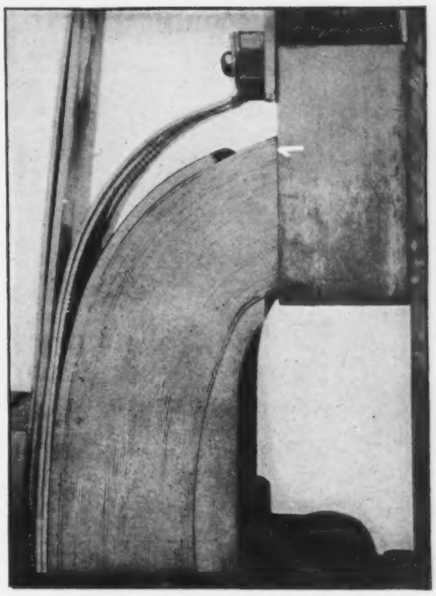
SAN FRANCISCO.....589 Howard St.
SEATTLE.....Pacific Block Bldg.
ST. LOUIS.....Railway Exchange Bldg.

The Why of GE Air Circuit Breaker Efficiency

The End-on Contact Brush



Upper End of Brush Just Making Contact



Brush Closed, Showing Extent of Wiping

G-E air circuit breaker brushes are so constructed and mounted that they possess an inherent tendency to retain exactly the curvature required. The laminations will not spring out of shape when the breaker is closed.

When the breaker is closed, each lamination makes end-on contact under heavy pressure uniformly distributed over the entire end surface.

These features are largely responsible for the high electrical efficiency shown by G-E air circuit breakers.

End-on contract under heavy pressure

—High electrical efficiency

—minimum heating

SET it—then FORGET it

General Electric Company

General Office: Schenectady, N. Y. **Sales offices in all large cities**

6755

"Here's Your Power" Shipped from Stock

Small RI Single Phase Motors

are meeting many rush demands for power. The machinist needs another tool grinder, the carpenter adds a band saw, the new shoe repair shop around the corner requires a motor—in short, small shops everywhere must have power.

The simplest and the quickest way is to drive each new machine by a Type RI Motor.

No line shafting necessary—no waits. Just call up the nearest G-E office or Motor Agency and ask for a stock shipment on a ¼, ½ or ¾ horsepower RI Motor. The power will soon be on the job.

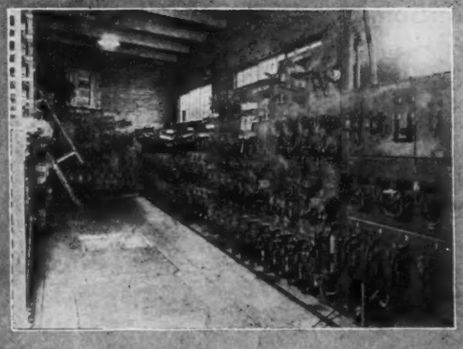
7410

General Electric Company

General Office: Schenectady, N. Y. Sales offices in all large cities

The Endurance Test

Where men work in eight hour shifts and often fail—but the machines go on forever.



And off in a little room, hundreds of electric fingers are sending messages to the electric motors that run the machines.

"Stop!" "Start!" "Slow!" "Reverse" is the endless, monotonous series of orders dispatched with the speed of lightning and the sureness of a trip-hammer blow.

Men may come and men may go at the steel plant but the G-E automatic motor control equipments keep up the heavy stream of steel production 24 hours a day, week in and week out.

This same degree of endurance is a quality of the automatic control we would recommend for your work. Ask our nearest office.

General Electric Company

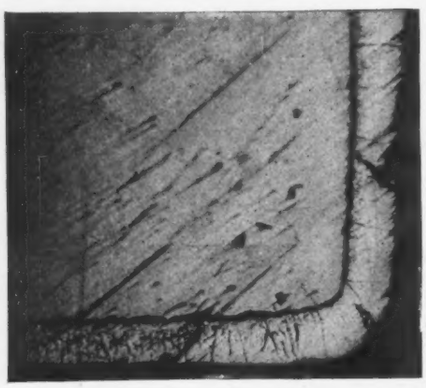
General Office: Schenectady, N. Y. Sales offices in all large cities

7055

Electric Sherardizing under *the* Microscope

The inordinate strength, the durability and the uniformity of the **Electrically** sherardized coating on steels is not generally understood. To explain these facts a microphotograph is shown in the insert at the left.

A piece of polished steel was **electrically** sherardized, cleaved to show the connection between coating and steel then magnified and photographed. Note the even thickness of this coating, **particularly at the corner.** Electric sherardizing made this possible.



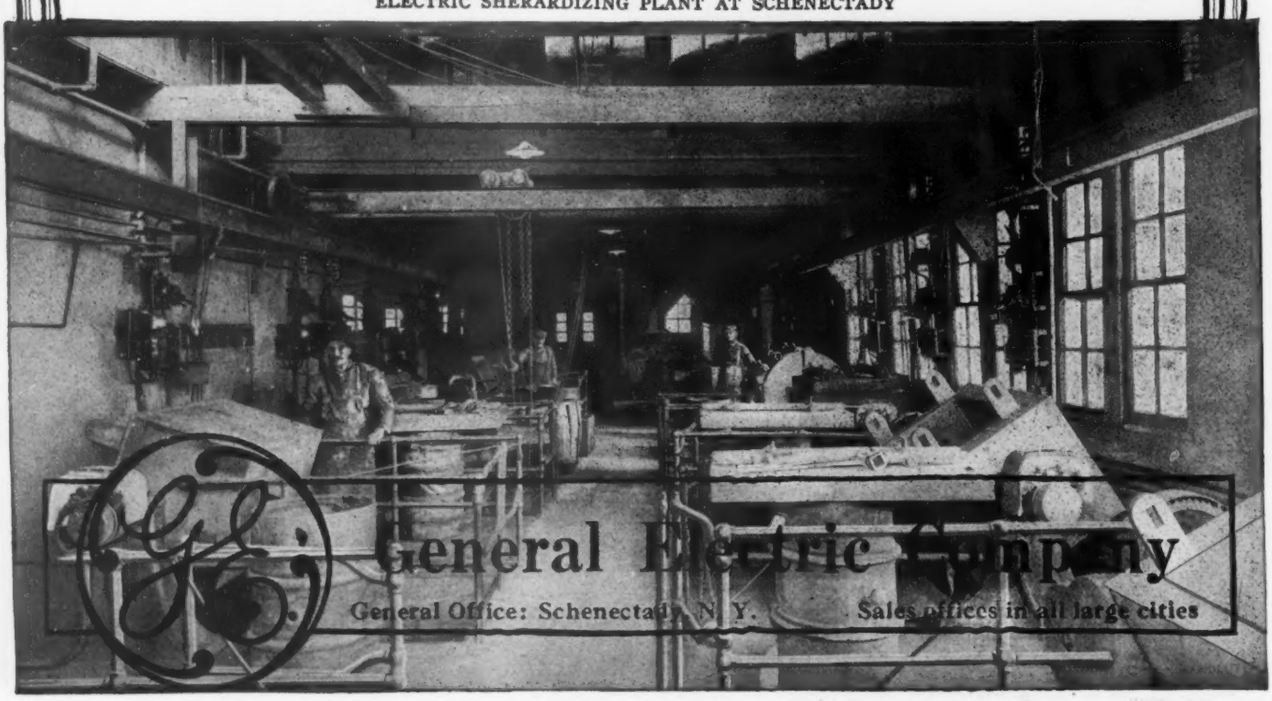
The black line between the coating and the steel is the juncture of the two substances. Small as it is shown, this juncture has been magnified 150 times.

The process of Electric Sherardizing, patented by the General Electric Company, supplies the means for successfully coating articles against rust. The final weatherproof coating, if desired, can be given a polish equal to nickel plating.

Write our nearest office for particulars relating to your own conditions. Ask for Bulletin 48926.

7350

ELECTRIC SHERARDIZING PLANT AT SCHENECTADY



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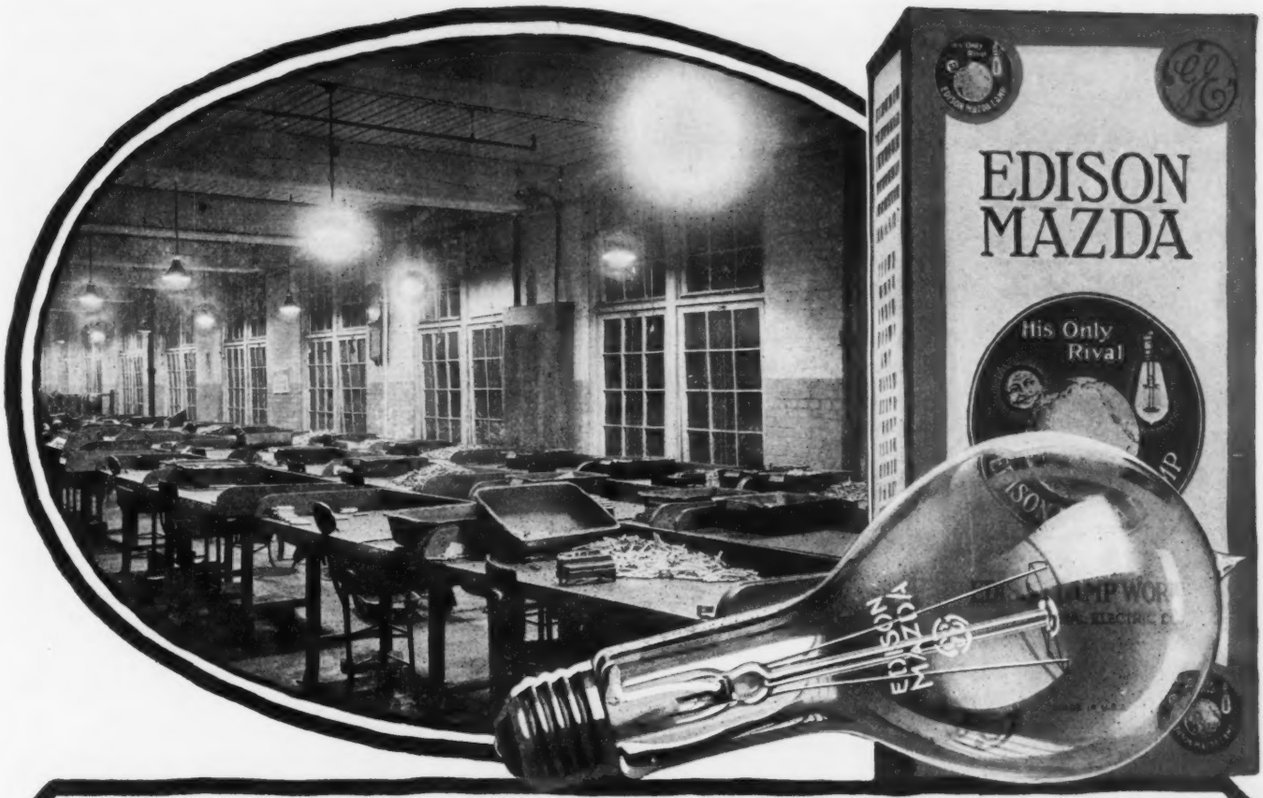
General Office: Schenectady, N. Y. Sales offices in all large cities



Errors in inspection go down when MAZDA C goes up!

SPOILAGE and waste due to errors in inspection slow up the whole plant, cut down production and increase operating costs.

Now that labor is so scarce and production facilities are strained to the limit, everything possible should be done to increase the unit efficiency of men, save unnecessary spoilage, waste of materials, and damage to equipment.

A prime necessity is adequate artificial light. Edison MAZDA C and MAZDA C-2 Lamps are the latest development in lighting.

MAZDA C is a specially developed lamp for commercial and industrial use. It is exceptionally powerful and allows night-time production to proceed with daytime efficiency, indoors and out.

MAZDA C-2 is a high power lamp with a blue glass bulb, designed especially for use where color comparison is necessary under artificial light.

The great need for increased production and the elimination of unnecessary errors and waste resulting from poor lighting should prompt every Edison MAZDA Lamp Distributor and Agent to urge the immediate adoption of these new lamps.

EDISON LAMP WORKS
of General Electric Company HARRISON, N. J.

7371

EDISON MAZDA

KERITE

AN INVESTMENT

When you put your money into KERITE you make an investment in service. You do more than buy conductors, insulation and protection. You obtain the best possible combination of the most desirable qualities in permanent form. KERITE remains long after the price is forgotten.

2

KERITE INSULATED WIRE & CABLE COMPANY
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PARANITE

RUBBER COVERED WIRES & CABLES

If it's PARANITE it's right
More than meets code requirements

Underground, Aerial, Submarine and Inside Use. Telephone, Telegraph, Fire Alarm, Electric Light and Power Wires and Cables.

THE BEST FOR EVERY PURPOSE

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When you buy

OKONITE Insulated Wires and Cables you do not just expect good service—you get it.

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8

Steel Taped Cables

MAXIMUM PROTECTION IS OBTAINED BY APPLYING THE TWO STEEL TAPES SPIRALLY IN OPPOSITE DIRECTIONS

You will be interested in samples and prices

SIMPLEX WIRE & CABLE Co
MANUFACTURERS
201 DEVONSHIRE ST. BOSTON
CHICAGO SAN FRANCISCO

Condensite

Withstands Oils and Chemicals

in fact this chemical agitator (made of Condensite) slops around in all kinds of chemicals and its just as good as ever

Oil is "bad medicine" for a great many insulating materials, but oil means nothing to CONDENSITE.

Why, you could leave a piece of CONDENSITE **MOLDED INSULATION** in a bath of oil for a week—or a year either—and not hurt it a bit.

In fact, as we here illustrate, implements devised for the agitation of chemicals are now manufactured from CONDENSITE. And we think that answers the question as to whether oils and chemicals can injure CONDENSITE Molded Insulation. We guess NOT!

And CONDENSITE Molded Insulation has every other property a good **insulating material** should have. *Get the facts.*

2008

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Bloomfield, New Jersey

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KVA.		Speed
1 45	Westinghouse, single-phase, 1100 or 2200 volts	900
1 50	Westinghouse, 2 - phase, rev. field, 2300 volts	1200
1 50	Westinghouse, revolv. field, 240 volts	1200
1 50	Gen. Elec., A.T.B., 3-phase, rev. field, 2300 volts	1200
3 56¼	Gen. Elec., 3-phase, rev. field, 2300 volts.	1200
1 60	Elec. Mach. Co., 3-phase, rev. field, 2300 volts	900
1 75	Fairbanks-Morse, 3-phase, rev. field, 2300 volts	900
1 75	Ridgeway, 3-phase, revolv. field, 2300 volts, direct connected to Ridgeway engine	300
1 100	Gen. Elec., ATB, 3-phase, 240 or 480 volts	900
1 100	Crocker-Wheeler, 3-phase, rev. field, 2300 volts to Harrisburg engine	257
1 100	Westinghouse, 3 - phase, rev. field, 2300 volts to McEwen engine	257
1 120	Westinghouse, 3 - phase, 2200 volts	720
1 180	Westinghouse, 3 - phase, 440 volts	514

240 VOLTS D. C. GENERATORS

KW.		Speed
1 3½	Fairbanks-Morse	1950
1 9	Milwaukee	575
1 12½	Western Elec	1425
1 20	Gen. Elec., CVC	1200
1 20	Ideal, Interpole, 125-250 volts, 3-wire	1150
1 30	Westinghouse	950
1 30	Sturtevant	600
1 30	C. & C., to Skinner engine	325
1 30	Ft Wayne, to Skinner engine	300
1 37½	Westinghouse	675
1 37½	Ft. Wayne, to Ideal engine	310
1 40	Westinghouse, to Fleming engine	350
1 50	Triumph	900
1 50	Card	650
1 50	Western Elec. to Ideal engine	280
2 50	Ft. Wayne, to Habercorn engine	275
1 55	Ft. Wayne 125-250 v., 3-wire	950
1 60	Western Elec., 125-250 volts, 3-wire, double-commutator	750
1 75	Thompson-Ryan, to Ridgeway engine	275
1 110	Gen. Elec. to Buffalo Forge engine	260

220 VOLT D. C. MOTORS

H.P.		Speed
10 1	Western Elec	1300
1 1	Holtzer-Cabot	1300
1 1	Jenney	1200
1 1	Watson	1200
1 1	Sprague-Lundell	1200
10 1	Western Elec	1150
1 1	Jenney, vertical	1125
1 1	Western Elec.,	900
1 1	Watson, vertical	900
1 1	Jenney, vertical	850
1 1	Gen. Elec., variable speed	500-1500
1 1¼	Gen. Elec	1700
1 1½	Allis-Chalmers	1600
1 1½	Northern	1975
1 1½	Crocker-Wheeler	1800
1 1½	Bartz - Wygand & Brown	1500
1 1½	Robbins & Myers	1500
1 1½	Browning, comp	1240
1 1½	Crocker-Wheeler	750
1 1½	Imperial, interpole	750
1 1½	Northern	400
1 2	Ft. Wayne	1800
1 2	Watson	1800
1 2	Roth	1550
1 2	Phoenix	1300
1 2	Gen. Elec., series, full load speed	1050
1 2	Holtzer-Cabot	1000
1 2	Crocker-Wheeler	700
1 2	Northern	500
1 2¼	Gen. Elec., CVC, variable speed	750-940
1 2½	Western Elec	1100
1 3	Roth	1825
1 3	Westinghouse	1800
1 3	Gen. Elec	1800
1 3	Sprague-Lundell	1600
1 3	Sprague-Lundell	1250
1 3	Western Elec	1200
1 3	Northern	1000
1 3	Jenney	850
1 3	Watson	800
1 3	Gen. Elec., variable speed	500-1500
1 3	Triumph	425
1 3½	Jantz & Leist	900
1 4	Westinghouse, interpole, variable speed.	600-1200
1 4½	Milwaukee	350
1 5	Gen. Elec	1650
1 5	Gen. Elec	1650
2 5	Gen. Elec., interpole, type CVC	1100
2 5	Crocker-Wheeler	950
1 5	Roth	925
1 7½	Jenney	1100
1 7½	Sprague-Lundell	1050
2 7½	National	900
1 7½	Allis-Chalmers	875
2 7½	Crocker-Wheeler	875
6 7½	Gen. Elec., Interpole, type CVC	825
1 7½	Jenney	810
4 7½	Gen. Elec., series, crane	800
1 7½	Gen. Elec., series, full load speed	750
1 7½	Northern, interpole, variable speed	600-900
1 7½	Sprague - Lundell, comp., printing-press motor	140
1 8½	Western Elec	900
1 10	Roth, MP, Advance 2 - stage centrifugal pump	1350
1 10	Diehl	1300
2 10	Eager	1200
1 10	Richmond	1200
1 10	Sprague-Lundell	1010
1 10	Kester	1000
1 10	Gibbs	950
1 10	Jenney	950
1 10	Sterling	825
1 10	Northern	650
1 10	Ft. Wayne	575
1 10	Milwaukee	450
1 15	Sprague, single-stage Advance centrifugal pump	1325
1 15	Western Elec., comp.	1250
1 15	Allis-Chalmers	800
1 15	National	725
1 15	Sprague	730
1 15	Northern	675
1 15	Gen. Elec., MP, series	600-2200
1 20	Thompson-Ryan, interpole	1000
1 20	Jenney, MP, vertical shaft	1000
1 20	Sprague, 6-pole, 2-stage centrifugal pump	750
1 20	C. & C. double-commutator, double-speed.	250-500
1 25	Gen. Elec. CL	1900
1 25	Gen. Elec., interpole, type CVC, comp.	1000
2 25	Gen. Elec., crane or hoisting motors, V.	625
2 30	Gen. Elec.	875
1 30	National	575
1 30	Western Elec	540
1 35	Sturtevant	525
2 40	Ideal	900
1 40	Westinghouse, MP, type M	750
1 40	Westinghouse, MP, type S, comp., with extra armature	550
1 45	Holtzer-Cabot, MP.	775
1 60	Triumph, MP, comp.	750
1 60	Ft. Wayne, 6-pole, type MPL	550
1 60	Card, MP, comp.	500
1 62½	Gen. Elec., series, crane or hoisting motor, on Bull	600-1700

500 VOLTS D. C.

H.P.		Speed
1 1	Colonial, MP	1775
2 1	Sprague-Lundell, encl. comp	1325
1 1⅛	Commercial	1700
1 1½	Sprague-Lundell, series, full load speed.	800
1 3	Westinghouse, MP, type S	2000
1 3	Gen. Elec., type CE.	1800
1 5	Western Elec., type SNI	1300
2 5	Gen. Elec., type CE.	1200
1 6½	Crocker-Wheeler, MP, form F, comp	1300
1 7½	Sprague	1650
1 7½	Crocker-Wheeler, MP, form I	950
2 10	Gen. Elec., MP, type CE	800
1 10	Ft. Wayne, MP, type E, comp	650
1 15	Sprague-Lundell, 6-pole	800
1 20	Jenney, MP, vertical shaft comp	1250
1 20	Gen. Elec., 6-pole, type CL, form B	750
1 50	Westinghouse, MP, type S, comp	825
1 50	Westinghouse, MP, type M	800
1 50	Gen. Elec., 6-pole, type CL, variable speed, with G.E. type R28 drum-controller and resistance	780-390
1 55	Gen. Elec., 6-pole, type CL	900
1 100	Gen. Elec., MP, form H, comp	700
1 110	Ft. Wayne, 6-pole, type LB, comp	600

25 CYCLE 3 PHASE GENERATORS

KVA.		Speed
1 300	Gen. Elec., 6600 volts, ATB	500
2	150 kw. Gen. Elec., rotary converters, 3-phase, 25-cycle, 372 volts, a.c. to 600-volt, 250-amp., d.c.	750

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2	50 amp., 110 v., 2 wire, single ph., type H, Sangamo.
9	100 amp., 110 v., 2 wire, single ph., type H, Sangamo.
7	10 amp., 110 v., 4 wire, 3 ph., type H, Sangamo.
3	20 amp., 110 v., 4 wire, 3 ph., type H, Sangamo.
2	40 amp., 110 v., 4 wire, 3 ph., type H, Sangamo.
2	50 amp., 220 v., 3 wire, D.C., type D5, Sangamo.
3	100 amp., 220 v., 3 wire, D.C., type D5, Sangamo.

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600	G.E.	250	..	120	22&44x36 McI. & S. C.C. H.
550	Allis	240	16	100	22&36x42 Allis C.C. H. Cor.
2—500	Ft. Wayne	250	..	90	22&38x48 Bates C.C. Cor.
500	C. W.	250	..	90	22&38x48 Hamilton C.C. Cor.
300	Goodman	250	8	150	19&32x24 McEwen T. C. H.
300	C. W.	250	..	100	22x42 Allis Corliss
250	C. W.	125/250	..	..	Ball-Wood Tand. Comp.
2—200	Sprague	125/250	..	..	De Laval Cond. Turbines
200	Ridg.	275	8	180	21x22 Ridgway
200	C. W.	250	12	178	14&25x21 Buckeye T. C. Hor.
160	G.E.	250	..	230	18x16 Ames
150	G.E.	250	..	100	14&22x36 Tand. Comp. Cor.
150	De Laval	125/250	..	900	De Laval Condensing Turbine
3—150	Allis	250	..	..	16x24 3 cyl. Diesel Oil
100	Westge.	250	..	265	Ideal Engine
3—100	C. & C.	250	..	200	9&18x21 Fitchburg T. C.
2—100	C. W.	250	..	250	Erie Ball Compound
80	F.-M.	250	..	..	12&18x13 Chand-Taylor T. C.
2— 75	Westge.	250	..	270	14x14 Payne Automatic
75	Westge.	250	..	300	12&20x12 Westge. Vert.
60	C. & C.	250	..	275	Ideal 13x12
50	Westge.	125/250	..	300	Erie Ball Simple

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300 KW, 550 volt, 450 RPM, 3 bearing.

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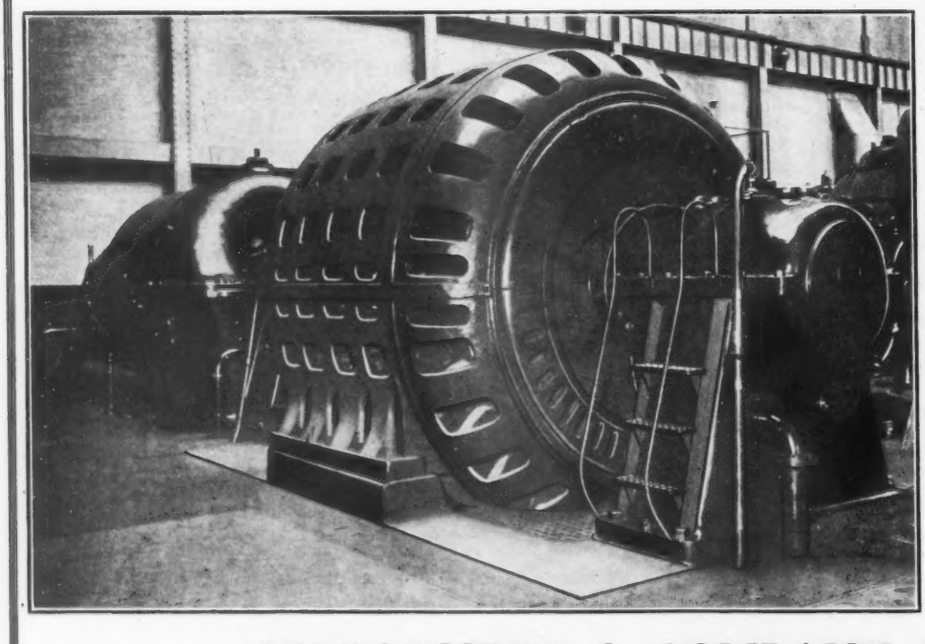

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4—535 KW. Allis-Chalmers generators, 3 phase, 60 cycle, 480 volts, 150 RPM., each direct connected to a 24″ x 36″ Allis-Chalmers tandem double acting producer gas engine.
1—340 KW. Westinghouse generator, 2 phase, 60 cycle, 440 volts, 325 RPM., direct connected to 23½″ x 33″ Power Mining Cach. Co. gas engine.
1—300 KW. General Electric generator, type ACC. phase, 60 cycle, 550 volts, 164 RPM., direct connected to two 16″ x 24″ 3-cylinder Diesel oil engines, vertical type. Complete with all accessories, including compressor, air bottles, etc.
1—300 KW. General Electric generator, type ATB, form B, 3 phase, 60 cycle, 2300 volts, 450 RPM., belted to two 16″ x 24″ 3-cylinder Diesel oil engines, vertical type, 167 RPM., complete with all accessories, including compressor, air bottles, etc.
1—300 KW. General Electric generator, 3 phase, 60 cycle, 600 volts, 164 RPM., direct connected to two 16″ x 24″ 3-cylinder Diesel vertical oil engines.
1—160 KW. Fort Wayne, type QRT, generator, 2 phase, 60 cycle, 2300 volts, 164 RPM., direct connected to 16″ x 24″ American Diesel oil engine, 2-cylinder, vertical. With Ingersoll-Rand compressor, air bottles, etc.
1—160 KW. Fort Wayne type QRT generator, 2 phase, 60 cycle, 2300 volts, 164 RPM., direct connected to 16″ x 24″ American Diesel oil engine, 3 cylinder, vertical, with Ingersoll-Rand compressor, air bottles, etc.
1—150 KW. General Electric type ATB generator, 3 phase, 60 cycle, 600 volts, 164 RPM., direct connected to 16″ x 24″ American Diesel oil engine, 3 cylinder, vertical, complete with air compressor and all auxiliary equipment.
1—125 KW. General Electric generator, type ATB, form M, 3 phase, 60 cycle, 240 volts, 200 RPM., direct connected to 14″ x 21″ 3-cylinder Diesel vertical oil engine, complete with compressor, air bottles, etc.
1—100 KW. Fort Wayne generator, 3 phase, 60 cycle, 240 volts, 225 RPM., direct connected to 12″ x 18″ 3-cylinder American Diesel vertical oil engine, complete with air compressor and all auxiliary equipment.
2—85 KW. units, each consisting of one 85 KW. Stanley generator, 2 phase, 60 cycle, 2400 volts, 225 RPM., direct connected to 12″ x 18″ 3-cylinder vertical Diesel oil engine, complete with Ingersoll Rand 2-stage air compressor, air bottles, etc.

DIRECT CURRENT UNITS

1—160 KW. Allis-Chalmers-Bullock generator, 250 volts, 160 RPM., direct connected to 16″ x 24″ Diesel 3-cylinder vertical oil engine, complete with air compressor, air bottles, etc.
2—150 KW. units, each consisting of one 150 KW. Fort Wayne type MPL generator, 250 volts, 165 RPM., direct connected to 16″ x 24″ Diesel 3-cylinder vertical oil engine.
1—130 KW. Crocker-Wheeler type CCD generator, 250 volts, 225 RPM., direct connected to a Buffalo twin tandem gas engine, size No. 16, built by Alberger Pump & Condenser Co., complete with all accessories.
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1—120 HP. Diesel oil engine, 12″ x 18″, 3-cylinder, vertical, with flywheel on either end of shaft, shaft extension for coupling to generator.
1—90 HP. Meeks & Weeks 4-cylinder oil engine, vertical, 320 RPM., with flexible coupling for direct connection.
1—50 HP. Fairbanks-Morse oil engine.
1—50 HP. De La Vergne horizontal oil engine.
1—44 HP. Fairbanks-Morse oil engine with National gas generator, oil burning carburetor for burning kerosene oil, 194 RPM., belt wheel 84″ dia. x 14″ face.
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1—15 HP. Fairbanks-Morse oil engine, type N.

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1—250 HP. American Crosley opposed cylinder gas engine.
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1—100 HP. American Crosley gas engine, single cylinder.
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1—60 HP. gas producer, also wet and dry scrubber.
1—60 HP. Alberger gas engine, 14″ x 14″, 2-cylinder, tandem compound, 225 RPM., with two flywheels and all accessories.
2—50 HP. International Harvester gas engines arranged with crutches for operating on same shaft.
1—40 HP. Lazier gas engine, 190 RPM.

We have on hand all classes of Power Machinery

MACGOVERN & COMPANY, INC.
114 Liberty Street, New York, N. Y.

SEARCHLIGHT SECTION

Meeting the Emergency is

We carry a large stock of Electrical Apparatus, Power House Equipment, Motors, and Air

Our Resources of Materials and Work That Has Been STANDARDized to PART OF OUR

NOTE.—**Ratings of our motors are** based on 40 deg. C. rise in temperature, unless otherwise specified. "R" appearing in the H.P. column indicates motors rated at 50 deg. C. rise.

MOTORS—3-PHASE, 60-CYCLE, 220 AND 440 VOLTS

No.	H.P.	Make	Type		R.p.m.	Avail.
3	1	Allis-Ch.	AM	New	1500	Stock Y
1	1	G.E.	K.Var.Spd.	Used	600/1800	Stock
4	1	Westgh.	CSA	New	1500	Stock
1	2	W.E.	KT	New	1200	Stock
2	2	Westgh.	CS	New	1200	Stock*
3	2	Howell.	SC	New	1800	Stock*
2	2	W.E.	KT	New	1800	Stock
3	2	Westgh.	CSA	New	1800	Stock
1	3	Westgh.	CS	New	1200	12/29
2	3	Howell.	SC	New	1800	Stock*
1	3	W.E.	KT	New	1800	Stock
6	3	Allis-Ch.	AN	New	1800	Stock
4	3	Westgh.	CS	New	1800	Stock
2	5	Howell.	SC	New	1200	Stock*
2	5	Westgh.	CS	New	1200	Stock
1	5	Westgh.	CCL	Used	1800	Stock R
5	5	Allis-Ch.	AR	New	1800	Stock
3	5	Howell.	SC	New	1800	Stock
1	7½	Westgh.	CCL	Used	1800	Stock
7	7½	Westgh.	CS	New	1800	Stock
1	7½	Howell.	SC	Used	1200	Stock
2	7½	Howell.	SC	New	1200	Stock*
1	7½	Allis-Ch.	ANEL	New	600	Stock
2	7½	W.E.	KT	New	1800	Stock*
3	7½	W.E.	KT	New	1200	12/17
1	7½	Allis-Ch.	AN	New	1800	Stock
3	7½	Allis-Ch.	AN	New	900	Stock Y
1	8	Westgh.	MS EL	Used	720	Stock
1	7½	Allis-Ch.	ANY	New	1200	Stock
2	10	Allis-Ch.	AN	New	900	Stock*
1	10	Allis-Ch.	AN	New	720	Stock Y
5	10	Allis-Ch.	AN	New	900	Stock* Y
1	10	Howell.	SC	New	1200	Stock Y
1	10	Allis-Ch.	ANY	New	1200	Stock
3	10	Allis-Ch.	ANY	New	1200	3/25
3	10	Allis-Ch.	ANY	New	900	3/25/18
1	15	Westgh.	CS	New	1200	Stock*
1	15	Wagner	SC	Used	1200	Stock R

MOTORS—3-PHASE, 60-CYCLE, 220 AND 440 VOLTS (Continued)

No.	H.P.	Make	Type		R.p.m.	Avail.
1	15	W.E.	KT	New	1200	Stock Y
1	15	Howell.	SC	New	1200	Stock Y
1	15	Allis-Ch.	AN	New	600	Stock Y
3	15	Allis-Ch.	ANY	New	1200	3/25
3	15	Allis-Ch.	ANY	New	900	3/25
1	20	Westgh.	CS	New	900	12/30
3	20	W.E.	KT	New	1200	12/21
3	20	W.E.	KT	New	1200	2/15 Y
2	20	W.E.	KT	New	900	12/21
1	20	Allis-Ch.	AN	New	900	Stock
2	20	Allis-Ch.	ANY	New	1200	Stock
2	20	Allis-Ch.	ANY	New	900	Stock 1 Y
4	20	FM.	KSS	New	1200	Stock
1	20	Westgh.	HF	Used	1200	Stock*
1	20	Westgh.	HF	Used	1200	Stock R
1	20	G.E.	M	Used	600	Stock R
1	20	Westgh.	HF	Used	1200	Stock R
1	20	Wagner	BREL	Used	900	Stock
2	20	Allis-Ch.	ANY	New	1200	3/25
2	20	Allis-Ch.	ANY	New	900	3/25
3	25	Westgh.	CS	New	900	12/31
1	30	Westgh.	CS	New	1200	12/31
2	30	Westgh.	CS	New	900	12/31
6	30	W.E.	KT	New	900	Stock* Y
4	30	Allis-Ch.	ANY	New	900	3/25
2	30	Allis-Ch.	ANY	New	1200	3/25
1	40	Westgh.	CS	New	1800	Stock Y
2	40	Westgh.	CS	New	900	12/31
5	40	W.E.	KT	New	900	2/15 Y
2	40	Allis-Ch.	AN	New	900	3/15 Y
2	40	Allis-Ch.	AN	New	1200	3/25
2	40	Westgh.	CW	New	900	2/15
4	40	Allis-Ch.	ANY	New	900	3/25 Y
2	40	Allis-Ch.	ANY	New	1200	3/25 Y
1	50	Westgh.	CS	New	900	12/30
9	50	W.E.	KT	New	900	12/22 Y
2	50	Allis-Ch.	AN	New	720	3/25
4	50	Allis-Ch.	AN	New	900	3/25 Y
1	50	Westgh.	CW	New	900	12/31 Y
15	50	W.E.	M	New	900	2/1 Y
1	50	W.E.	M	New	720	2/5 Y

MOTORS—3-PHASE, 60-CYCLE, 220 AND 440 VOLTS (Continued)

No.	H.P.	Make	Type		R.p.m.	Avail.
14	50	Allis-Ch.	ANY	New	900	1/7 Y
2	75	Westgh.	CS	New	1800	2/6 Y
3	75	Allis-Ch.	AN	New	900	3/25 Y
1	75	Westgh.	CW	New	720	12/31 Y
1	75	Westgh.	CW	New	900	12/31 Y
1	75	W.E.	M	New	600	1/22 Y
6	75	Allis-Ch.	ANY	New	900	3/25 Y
6	75	Allis-Ch.	ANY	New	720	3/25 Y
1	90R	Westgh.	CW	New	720	12/31 Y
1	90R	Westgh.	CW	New	900	12/31 Y
2	100	Allis-Ch.	ANY	New	600	3/25 Y
4	100	Allis-Ch.	ANY	New	720	3/25 Y
4	100	Allis-Ch.	ANY	New	900	3/25 Y
4	150	Allis-Ch.	ANY	New	720	3/25 Y
4	150	Allis-Ch.	ANY	New	600	3/25 Y
5	150	Westgh.	CW	New	720	12/31 Y
1	150	Westgh.	CCL3bbd.	Used	514	Stock
5	175R	Westgh.	CW	New	720	12/31 Y
4	200	Allis-Ch.	ANY	New	600	3/25 Y

MOTORS—3-PHASE, 60-CYCLE, 550-VOLT

3	5	Westgh.	CS	New	1300	12/17 Y
2	7½	Westgh.	CS	New	1800	12/17 Y
5	15	Westgh.	CS	New	1800	12/28 Y
6	15	Westgh.	CS	New	1800	Stock*
2	25	Westgh.	CS	New	1800	12/28 Y
1	25	W.E.	KT	New	600	Stock*
1	25	Westgh.	CS	New	900	Stock*
1	30	W.E.	KT	New	600	Stock*

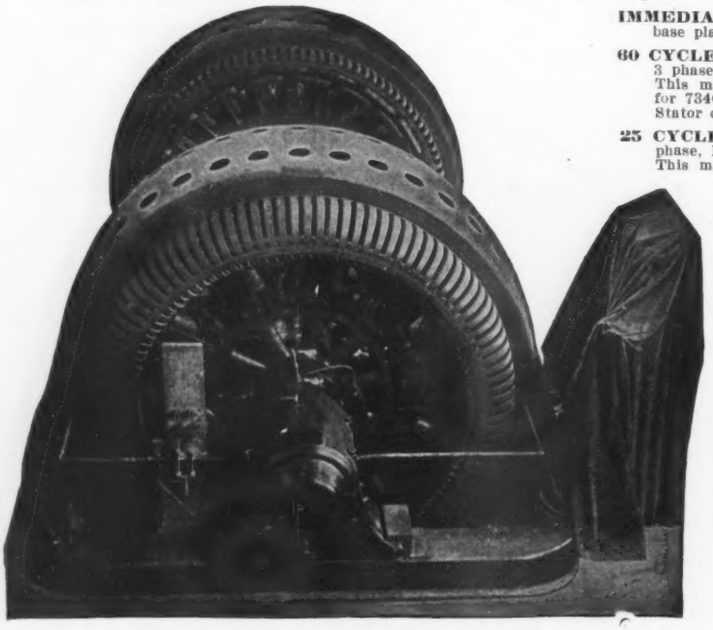
MOTORS—3-PHASE, 15-CYCLE, 2200 VOLTS

1	100	W.E.	M	New	750	2/15
1	150	W.E.	M	New	750	2/15

MOTORS—3-PHASE, 60-CYCLE, 2200 VOLTS

2	75	W.E.	M	New	900	3/15
2	75	Allis-Ch.	ANY	New	900	3/25
1	75	W.E.	M	New	720	3/25
2	75	Allis-Ch.	ANY	New	720	3/25
1	100	W.E.	M	New	600	4/12
4	100	W.E.	M	New	720	5/17
4	100	Allis-Ch.	ANY	New	720	3/25
4	100	Allis-Ch.	ANY	New	900	3/25

4000 K. W. G. E. Frequency Changer Set



IMMEDIATE SHIPMENT—Operated 2 years—4 bearings combined base plate. Will start from either end. 300 RPM—Open type.

60 CYCLE END—ATI—24 pole, 4150-300 RPM, 11,000 volts, Form C, 3 phase, H.P. 5600. Amps. 231. Ser. No. 181917.
This machine can be reconnected at additional expense to purchaser for 7340-5500-3670-2750-6350-4140-3175-2120 volts.
Stator coils, chain type. Maximum excitation 40 KW at 125 volts.

25 CYCLE END—ATB—10 pole, 300 RPM, 13,200 volts, Form C, 3 phase, KW 4000. Amps. 175. Ser. No. 181916.
This machine can be reconnected at additional expense to purchaser for 5270-2650-7630-3400 volts. Stator coils, Barrel type. Maximum excitation 35 KW at 125 volts.

RHEOSTATS—Have the original hand operated face plate rheostats.

DAMPERS—60 cycle end is equipped with dampers.

EXCITERS—None with set—We can probably supply exciter sets if required.

COMPENSATOR and OIL SWITCH—None with set.

GUARANTEES—Factory guaranteed combined efficiency of set 1¼ load, 91.2%; full load, 90.2%; ¾ load, 88.5%; ½ load, 84.5%. Temperature rise 40° C., and 55% for 2 hours at 125% load.

AGE—SERVICE—Purchased in March, 1908, put in service Dec., 1908, and operated until Jan., 1911, a period of 2 years and 1 month, and was never materially overloaded.

BED PLATE—Combined C.I. box section approximately 23' 6" x 15' 4".

FOUNDATION PLANS—We can supply copies of foundation plan immediately.

WEIGHT—Shipping weight estimated at 260,000 lbs.

SPARE COILS—Probably some spare coils will be available, possibly one of each shape.

LOCATION—San Francisco. Telegraph our Baltimore, Md., office to arrange for inspection.

WHY FOR SALE—Power Purchase contract was fulfilled.

STANDARD ELECTRIC & ELEV. CO., Inc.

SEARCHLIGHT SECTION

Standard Practice

BALTIMORE ELECTRIC & ELEV. CO., Inc.

Compressors, New and Used, all of which we Guarantee both Electrically and Mechanically

Trained Men Are at Your Disposal

Meet Your Requirements Will Serve You Well

STOCK IS LISTED BELOW

MOTORS—3 PHASE, 60 CYCLE, 2200 VOLTS
(Continued)

No.	H.P.	Make	Type		R.p.m.	Avail
5	150	Wagner	BFSyn.	Used	900	Stock*
2	150	W.E.	M	New	600	3/25
2	150	W.E.	M	New	720	3/25
4	150	Allis-Ch.	ANY	New	600	3/25
4	150	Allis-Ch.	ANY	New	720	3/25
5	200	W.E.	M	New	600	5/1
1	200	Westgh.	CW	New	720	1/15
1	250	W.E.	M3bbd.	New	514	5/1
2	250	W.E.	M3bbd.	New	600	5/1

MOTORS—3-PHASE, 25-CYCLE, 220 VOLTS

3	2	Westgh.	CS	New	720	12/17 Y
3	2	Westgh.	CS	New	1500	Stock
2	3	Westgh.	CS	New	750	12/17
5	7½	Westgh.	CS	New	750	12/28 Y
1	7½	Alis-Ch.	AN	New	750	Stock
2	10	Westgh.	CS	New	750	12/28 Y
1	10	W.E.	K	New	750	12/17 Y
1	15	Allis-Ch.	AN	New	1500	Stock R
3	15	W.E.	K	New	750	12/28 Y
1	15	Allis-Ch.	ANY	New	750	Stock Y
3	20	W.E.	K	New	750	Stock 11Y
3	20	Allis-Ch.	AN	New	750	12/17, 1/25, 3/25 Y
3	30	W.E.	K	New	750	Stock* Y
2	30	Allis-Ch.	AN	New	750	3/25 Y
3	40	W.E.	K	New	750	1/11 Y
2	40	Westgh.	CS	New	750	12/17 Y
2	40	Allis-Ch.	AN	New	750	3/25 Y
1	40	Westgh.	CW	New	750	12/31 Y
2	40	Allis-Ch.	ANY	New	750	3/25 Y
1	50	Westgh.	CS	New	750	1/7 Y
2	50	Allis-Ch.	AN	New	750	3/35 Y
2	50	Westgh.	CW	New	750	12/31 Y
4	50	Allis-Ch.	ANY	New	750	3/25 Y
1	75	Westgh.	CX	Used	500	Stock R
4	75	Allis-Ch.	ANY	New	750	3/25 Y
2	100	Allis-Ch.	ANY	New	500	3/25 Y
4	100	Allis-Ch.	ANY	New	750	3/25 Y
1	150	W.E.	M	New	750	2/3 Y
2	150	Allis-Ch.	ANY	New	750	3/25 Y
2	150	Allis-Ch.	ANY	New	500	3/25 Y
2	200	Allis-Ch.	ANY	3bdg. New	500	3/25Y
1	200	W.E.	M 3bdg.	New	500	4/15 Y
1	250	W.E.	M 3bdg	New	500	4/15 Y

MOTORS—3-PHASE, 25-CYCLE, 440 VOLTS

3	1	Westgh.	CSA	New	750	Stock
3	2	Westgh.	CS	New	750	12/17
3	2	Westgh.	CS	New	1500	Stock Y
2	3	Westgh.	CS	New	750	12/17 Y
5	7½	Westgh.	CS	New	750	12/28
1	7½	Allis-Ch.	AN	New	750	Stock Y
2	10	Westgh.	CS	New	750	12/28
1	10	W.E.	K	New	750	12/17
1	15	Allis-Ch.	AN	New	1500	Stock R
3	15	W.E.	M	New	750	12/28
1	15	Allis-Ch.	ANY	New	750	Stock
3	20	W.E.	K	New	750	Stock*
3	20	Allis-Ch.	AN	New	750	12/17 1-2-3/25
3	30	W.E.	K	New	750	Stock*
2	30	Allis-Ch.	AN	New	750	3/25
3	40	W.E.	K	New	750	1/11
2	40	Westgh.	CS	New	750	12/17
2	40	Allis-Ch.	AN	New	750	3/25
1	40	Westgh.	CN	New	750	12/31
2	40	Allis-Ch.	ANY	New	750	3/25
1	50	Westgh.	CS	New	750	1/7
2	50	Allis-Ch.	AN	New	750	3/25
2	50	Westgh.	CW	New	750	12/31
4	50	Allis-Ch.	ANY	New	750	3/25
1	75	Westgh.	CX	Used	500	Stock R
4	75	Allis-Ch.	ANY	New	750	3/25
2	100	Allis-Ch.	ANY	New	500	3/25
4	100	Allis-Ch.	ANY	New	750	3/25
1	150	W.E.	M	New	750	2/23
2	150	Allis-Ch.	ANY	New	750	3/25
2	150	Allis-Ch.	ANY	New	500	3/25
2	200	Allis-Ch.	ANY	3bdg. New	500	3/25
1	200	W.E.	M 3bdg.	New	500	4/15
1	250	W.E.	M 3 bdg.	New	500	4/15

MOTORS—220-VOLT, DIRECT CURRENT

1	2	G.E.	Grinder	Used	1650	Stock
1	2	Richmond	SH	Used	1600	Stock
1	3½	G.E.	GE	Used	800	Stock R
1	6	Otis	Cpd.El.	Used	950	Stock R
1	7½	Richmond	RE	Used	1500	Stock
1	7½	Eddy	SH	Used	1000	Stock R
1	10	Westg.	M	Used	1250	Stock R
1	15	C.W.	SH	Used	725	Stock

MOTORS—220-VOLT, DIRECT CURRENT
(Continued)

No.	H.P.	Make	Type		R.p.m.	Avail.
1	20	Ft. Wayne	CPD	Used	820	Stock R
1	25	C.W.	SH	Used	800	Stock R
1	25	Westgh.	Series	Used	750	Stock
1	250	Westgh.	CPD	Used	500	Stock

MOTORS—110-VOLT, DIRECT CURRENT

1	½	Fidelity	SH	Used	1600	Stock
1	¾	Westgh.	B	Used	1300	Stock
1	1¼	Diehl	SH	Used	1180	Stock R
1	3½	Jeffery	SH	Used	1500	Stock
1	20	C. & C.	CPD	Used	1150	Stock Y
1	25	Westgh.	G	Used	850	Stock
1	30	Westgh.	M	Used	975	Stock
1	40	Westgh.	M	Used	950	Stock
1	60	Westgh.	MA	Used	1000	Stock

MOTORS—550-VOLT, DIRECT CURRENT

1	10	Westgh.	S	Used	615	Stock
1	15	Allis-Ch.	S	Used	1350	Stock

GENERATORS BELTED DIRECT CURRENT (USED)

1	1¼	Westgh.	Used	110	1650	Stock
1	10	Westgh.	S used	125	1325	Stock R
1	10	Westgh.	S used	110	1325	Stock
1	17½	C. C.	CPD used	125	1150	Stock
1	18½	Westgh.	S used	125	950	Stock
1	200	Westgh.	compd.used	250	500	Stock

MOTOR OR GENERATOR

1—200 KW., 250-volt D.C., 580 r.p.m., Westinghouse Compound Wound 6-pole generator, with Flexible Coupling.

BELTED A. C. GENERATORS

1—75 KW. 3-ph., 60-cy., 440-v., 720 r.p.m. used Warren inductor type rev. fld. generator, complete with rheostat, exciter, pulley and rails. Shipment within two weeks after receipt of order.

1—125 KVA. 3-ph., 60-cy., 2300-v., 900 r.p.m. rev. fld. Wagner belted type generator, complete with exciter and switchboard. This machine will also make a synchronous motor. We have suitable starting equipment.

A. C. TURBO GENERATOR SETS

1—500 KW., 3-ph., 60-cy., 2300-volt, 3600 r.p.m. Westinghouse Parsons Turbo-Generator with Alberger counter current surface condenser, size 2000. Complete with accessories and fittings.

1—25 KW., 125-volt, 200 amp., Westinghouse engine-driven exciter set.

1—Generator panel complete, also instrument and rheostat for exciter.

D. C. GENERATORS—BELTED, 250-VOLT

1—200 KW., 250-volt, D.C. 500 r.p.m. Westinghouse compound wound, 6-pole generator, complete with pulley, base and rheostat. Complete outfit in first class condition. For immediate shipment.

SWITCHBOARDS

1—Switchboard board panel with
1—300 amp. 250 v. I.T.E. circuit breaker.
1—500 amp. Weston Ammeter.
1—2-way voltmeter receptacle.
1—300-amp. 3-pole S. T. switch.
1—Weston voltmeter and bracket.

TRANSFORMERS (NEW)

3—750 KVA. single-phase, 25 cy., 34600-32870-31140 v., primary, 2300 v. secondary. O. F. S. C. Allis-Chalmers transformers. For immediate delivery.

1—7½ KVA. single phase 60 cy. 2400 to 240-120 v. Westg. type "S" transformer complete. In our stock.

3—600 KVA. single-phase, 60-cy., 13,200 to 2,300 volts, with 3-3% full capacity taps. Westinghouse Outdoor Type OISC Transformers (used). For immediate delivery.

3—500 KVA. New G.E. Transformers, same characteristics as above. For immediate delivery.

AIR COMPRESSOR—High Pressure

1—1100 lbs. used Ingersoll Class N3, 180 r.p.m., 146 cu. ft. piston displacement, 10 in. by 6½ in. by 3 in. by 12 in. Air cylinder complete with air tank. Practically new, only used a few months.

NEW AIR COMPRESSORS—Belted Types

No.	Size	Class	Capacity, Cu. Ft.	Pressure Lbs.
4	6x6	A-E	35 to 59	125
2	7x6	A-E	54 to 80	100
1	8x6	A-E	60 to 105	70
7	8x8	A-E	79 to 116	125
3	9x8	A-E	100 to 147	100
2	10x8	A-E	123 to 181	80
3	12x8	A-E	176 to 261	55
10	10x10	A-E	145 to 204	125
1	11x10	A-E	176 to 248	100
1	12x10	A-E	208 to 294	85
1	14x10	A-E	284 to 400	65
7	12x12	A-E	235 to 314	125

STEAM DRIVEN AIR COMPRESSORS

3	6x6x6	35 to 59	125
4	6x7x6	54 to 80	100
8	8x8x8	79 to 116	125
1	8x9x8	100 to 147	100
2	8x10x8	123 to 181	80
8	10x10x10	145 to 204	125
6	12x12x12	235 to 314	125

NOTE: We also have available for immediate shipment a number of small vertical belted type air compressors ranging from 7 to 30 cu. ft. capacity. Larger machines, two stage, up to 800 cu. ft. capacity are available and we will be pleased to submit our proposition.

MR. GLASS FACTORY MAN!
HERE IS SOMETHING FOR YOU

1—14 in. by 16 in. by 14 in. Cox Duplex Steam drive air compressor, 60 lbs. air pressure, 600 cu. ft. at 100 r.p.m. In excellent condition.

IMMEDIATE DELIVERY

99,000,000 Beam Candle Power

GENERAL ELECTRIC

Navy Type
SEARCHLIGHT PROJECTOR

With 48-inch mirror reflector. For operation on 125 volt D. C. at 130 Amperes.

Mounted on revolving turret and operated by geared hand control

Also a lot of Carbon Electrodes.

Foot of Calvert Street, Baltimore, Md.

SEARCHLIGHT SECTION

SELECTIONS FROM OUR STOCK OF TURBINES, MOTORS, TRANSFORMERS MOTOR GENERATORS, Etc.

Let us know your requirements as we carry a large stock of various classes of electrical machinery other than the items mentioned below

TURBINES

1—150 KVA., 3-phase, 60 cycle, 3600 rpm., 220-volt, Westinghouse-Parsons Turbo-Generator, with direct connected exciter, excellent condition.

1—250 KW (GENERATOR ONLY), 3-phase, 60-cycle, 440-volt, 3600 rpm. Crocker-Wheeler turbine type generator.

D. C. 250-Volt Direct Connected Sets

1—15 KW, 400 rpm. Sturtevant vertical Set.

1—30 KW, Westinghouse to a straight line engine.

1—30 KW, 300 rpm., NEW General Electric engine type generator.

1—50 KW, 275 rpm., NEW Crocker-Wheeler engine type generator.

A. C. DIRECT CONNECTED SETS

1—40 KW, .8 P.F., 50 KVA., 3-phase, 60-cycle, 2300-volt type ATB" Form "E," 300 rpm., G.E. alternator direct connected to a 11x10 Erie City Iron Works Engine, with a 5 KW., 125-volt, 1800 rpm., type "CVC" G.E. exciter and switchboard.

1—60 KW, .8 P.F., 75 KVA., 3-phase, 60-cycle, 2300-volt, type "ATB," form "E," 300 rpm., G.E. alternator, direct connected to a 13x12 Erie City Iron Works engine, with 7 KW., 125-volts, 1800 rpm., G.E. type "CVC" exciter and switchboard.

ADJUSTABLE SPEED MOTORS WITH REGULATORS

Qu.	H.P.	Make	Type	Volts	Speed
1	1	G.E.	CR	220	525/1050
1	3½	Burke		220	935/1600
3	4	Northern		220	387/857
1	4	Wstg.	SA	220	400/1600
1	4½	G.E.	RLC	220	600/1200
1	5	Stow		110	700/1575
1	5	Northern		220	500/1000

Qu.	H.P.	Make	Volts	Type	Speed
1	7½	G.E.	CR 500		450/900
1	15	Reliance	110		550/1100
1	25	G.E.NEW	BR 230		400/800
1	35	Th-Ryan	230		300/800

3-PHASE, 60-CYCLE MOTORS

Qu.	H.P.	Make	Volts	Type	Speed
1	½	G.E.NEW	110	KT	1800
1	½	G.E.	110	I	1800
1	1	Fbks.-M	440	B	1200
2	2	Wstg.	440	CS	1120
1	2	G.E.	110	I	1800
2	2	G.E.	220	KT	900
6	3	WstgNEW	220	CS	1130
4	3	G.E.	220	KT	1800
1	3	G.E.	220	KT	900
2	3	R. & M. NEW	220		1150
1	3	Cr.-Wh	220		1720
1	3	Fbks.-M	220	B	1200
2	3	G.E.	220	KT	1200
2	5	G.E.NEW	220	KT	1800
4	5	G.E.NEW	220	KT	1200
1	5	G.E.	220	KT	1800
2	5	Wstg.	220	CCL	580
10	5	Wstg.NEW	220	CS	1735
3	5	WstgNEW	220	CS	1130
30	7	G.E.	550		1200
1	7½	G.E.	220		1800
1	7½-15	Cr.-Wh.	220/440		865/1735
5	7½	G.E.NEW	220	KT	1800
4	7½	G.E.NEW	220	KT	1200
6	7½	G.E.	550	KT	1800
2	7½	G.E.NEW	220	KT	900
1	10	Wstg.	220	CS	1150
1	10	Cr.-Wh	550	Q	1800
1	10	Wstg.	220	CCL	1700
2	10	G.E.NEW	220	KT	1800
4	15	R. & M.	220		1150
4	15	Fbks.-M.	220/440	KBV	1200
2	20	Wstg.	220	CS	1160
1	20	Cr.-Wh	220/440		1200
1	20	Triumph	220/440		900
1	20	Fbks.-M	220	B	1200
100	20	Fbks.-M.	220/440	KBV	1200
1	25	G.E.	220	M	900
38	25	Wagner	220/440	BP	1120
4	30	Wagner NEW	220		850
1	35	G.E.	220	KT	720
1	40	Wagner NEW	220/440	BP	850

Qu.	H.P.	Make	Volts	Type	Speed
1	40	Fbks.-M	220		900
2	40	G.ENEW	220	KT	1200
1	50	Triumph	220		720
1	50	G.E.NEW	220	KT	900
2	50	G.E.NEW	440	KT	900
1	50	G.E.NEW	220	KT	1200
1	50	G.E. slip ring	220	M	900
2	75	G.E.NEW	220/440	K	900
1	125	G.E.	2200	L	600
1	150	Wstg.NEW	440	CW	695
1	200	Wstg.	2200	CCL	580
1	263	G.E. synch. with direct-connected exciter.	2200		600

3-PHASE, 25-CYCLE MOTORS

Qu.	H.P.	Make	Volts	Type	Speed
1	5	G.E.	220	KT	750
1	12½	G.E., elev. type, high torque	220	KTE	750
1	15	Fbks.-M	440	B	750
6	15	Allis-Ch	220		750
7	20	Allis-Ch	220		750
2	20	G.E.	440	K	750
6	25	G.E.	440	K	750
1	50	Allis-Ch., intermittent duty, sl. rg. drum controller	440		500
1	55	Wstg., sl. rg., 30 cycles, complete	440		860
1	60/45/30	G.E.	440	500/375/250	

220-VOLT DIRECT CURRENT MOTORS

Qu.	H.P.	Make	Type	Speed
1	10	Browning		1260
1	15	Bullock		1600
1	20	Fbks.-M		950
1	20	Wstg. cpd	S	975
5	20	Westinghouse	S	975

Qu.	H.P.	Make	Type	Speed
1	20	Cr.-Wh	D	775
1	20	G.E.	CE	1040
1	20	G.E.	DLC	525
1	25	Northern		635
1	25	Cr.-Wh	I	750
1	25	Gen. Elec. NEW compd	BRK	400/800
1	25	Gen. Elec.	BR	1750
1	27	Wood	EF	625
1	30	Gen. Elec.	DLC	950
1	30	Allis-Ch		950
1	35	Cr.-Wh	I	700
1	35	Th.-Ryan		300/800
1	40	Gen. Elec. NEW	BRK	900
1	50	Gen. Elec. NEW Vertical	BV	750
1	55	Gen. Elec. compd	CLB	900
2	60	Gen. Elec. NEW	Co-2507	700
4	75	Gen. Elec., crane type	GE-211	350
1	125	Cr.-Wh	D	550

TRANSFORMERS—Single Phase

Qu.	Kw.	Make	Cy.	Type	Voltage
4	15	G.E.	60	H	1040–2080/104–208
1	20	G.E.	60	H	1040–2080x104/208
1	25	Wstg.	60	OD	13200x110–220
1	25	G.E.	60	HE	1040/2080x104/208
1	25	G.E.	60	H	1040/2080x104x208
2	100	Wstg.		water cooled	11000-2500
2	110	Wstg.	60	OISC	2200x180–360
3	200	Wstg.	29	OISC	22000x410
1	250	Wstg.	60	OISC	13200x200/440
2	300	Bullock	60		6600–2200

Three Phase

3	5	Wstg.	60	ST	2100/2200x220–440
2	5	G.E.	60	HT	2080Yx230/460
1	7½	Wstg.	60	ST	2300x220–440
1	7½	G.E.	60	HT	2080Yx230–460
2	15	Wstg.	60	ST	2100/2200x220–440
2	30	G.E.	60	HT	2080Yx230–460

GEORGE SACHSENMAIER & CO., Office and Salesrooms: 141-43-45 No. 3rd St., Warehouse and Shop: 928-30-32 No. 3rd St., **Phila.**

LET US KNOW WHAT YOU HAVE FOR SALE

MOTORS

100 H. P. Westinghouse, 200 V. DC., 680 rev. "M."

15 H. P. General Electric, 500 V. DC., 1200 rev.

10 H. P. Westinghouse, 500 V. DC., 1250 rev. "M."

3 Phase, 60 Cycle

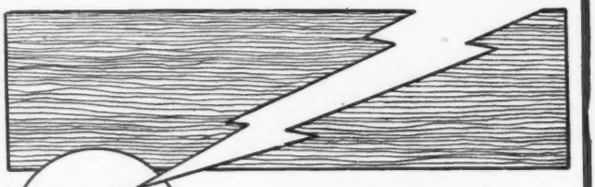
35 H. P. Burke, 220 volts, 900 rev.
30 H. P. Fairbanks, 220 volts, 900 rev.
30 H. P. Burke, 220 volts, 1800 rev.
20 H. P. Burke, 220 volts, 900 rev.
20 H. P. Fairbanks, 220 volts, 900 rev.
30 H. P. Westinghouse, 220 volts, 575 rev.
10 H. P. General Electric, 220 volts, 900 rev.
3 H. P. Wagner, 220 volts, 1700 rev.

2 Phase, 60 Cycle

10 H. P. Wagner, 220/440 volts, 1140 rev.
10 H. P. Wagner, 220 volts, 1720 rev.
10 H. P. Fairbanks, 220 volts, 1200 rev.
10 H. P. Fairbanks, 220 volts, 1800 rev.
5 H. P. Wagner, 220 volts, 1720 rev.
1 H. P. General Electric, 220 volts, 1800 rev.
1 H. P. Fairbanks, 220 volts, 1800 rev.

Excellent condition. Immediate stock shipment.

McCOY-BRANDT MACHINERY CO.
216-218 Penn Ave., Pittsburgh, Pa.



Immediate Shipment

New 25 Cycle Alternators

3—New G. E. ATI-18-900 KVA (750 KW) 167 rev. 6600 volt (can reconnect 2200 volt), 3-phase, 25-cycle alternators, less bases, but with shaft and one bearing.

These machines are equipped with direct-connected MPC-6-20 KW 167 rev., 125 volt exciters. Each exciter is mounted upon a pedestal, the base of which extends under the pedestal of the outboard bearing to rigidly tie the two together.

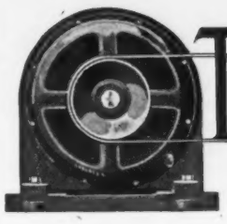
The machines can be modified mechanically, and may be used as synchronous motors. Blueprints, prices, and further information as to modification, will be furnished upon application.

In stock at Schenectady, N. Y. Sold singly if desired.

PURCHASING DEPT.

MIAMI COPPER CO.
61 Broadway, New York, N. Y.

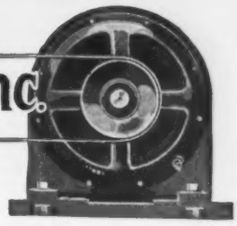
SEARCHLIGHT SECTION



TIFFANY HALL & CO., Inc.

ELECTRICAL EQUIPMENT - ENGINEERS

ALSO SPECIALISTS IN HEAVY AND DIFFICULT REPAIRS



In Stock—MOTORS

Stock No.	H.P.	Volts	Speed	Phase	Cycles	Make and Type	Shipment
1179	450	440	450	3	60	Westinghouse, Syn	2 weeks
966A	400	230	400	D.C.	D.C.	Westinghouse. 3 bearing	2 weeks
1240	225	2200	690	3	60	Westinghouse slip ring, new	4 weeks
1177	200	550	690	3	60	Westinghouse, C.S., New	Immediate
1225	200	440	500	3	25	Gen. Elec. K.	1 week
1226	150	220/440	500	3	25	Westinghouse, Sq.Cage	1 week
1219	150	2200	690	3	60	Westinghouse, Sq. Cage	Immediate
1139	100	220/440	1150	3	60	Westinghouse, Sq. Cage	2 weeks
1189A	100	230	775	D.C.	D.C.	Westinghouse, S.	1 week
1188	100	230	650	D.C.	D.C.	Westinghouse, S.	10 days
1200	75	440/220	900	3	60	Westinghouse, slip ring.	Immediate
1201	75	440/220	900	3	60	Westinghouse, slip ring.	Immediate
1202	75	440/220	900	3	60	Westinghouse, slip ring.	Immediate
1129A	75	440/220	600	3	60	Allis-Chalmers Sq. Cage	2 weeks
1072	75	220/440	720	3	60	Gen. Elec. Form L	Immediate
1096	75	440/220	900	3	60	Gen. Elec. slip ring	2 weeks
1129	60	220/440	480	3	60	Allis-Chalmers Sq. Cage	2 Weeks
1227	60	230	750	D.C.	D.C.	Allis-Chalmers Bullock	Immediate
1228	60	230	450/600	D.C.	D.C.	Gen. Elec. CLB	Immediate
839	50	440/220	1200	3	60	Gen. Elec. Sq. Cage	Immediate
841	50	440/220	1200	3	60	Gen. Elec., Sq. Cage	Immediate
842	50	440/220	1200	3	60	Gen. Elec., Sq. Cage	Immediate
843	50	440/220	1200	3	60	Gen. Elec., Sq. Cage	Immediate
849	50	440/220	1200	3	60	Gen. Elec., Sq. Cage	Immediate
850	50	440/220	1200	3	60	Gen. Elec., Sq. Cage	Immediate
851	50	440/220	1200	2	60	Gen. Elec., Sq. Cage	Immediate
853	50	440/220	1200	2	60	Gen. Elec., Sq. Cage	Immediate
1229	50	440/220	900	3	60	Gen. Elec., K	Immediate
1230	50	440/220	900	3	60	Gen. Elec., K	1 week
1231	50	440/220	900	3	60	Gen. Elec., K	2 Weeks
1191	50	440/220	900	3	60	Westinghouse, CX	2 weeks
1099	50	440/220	900	3	60	Gen. Elec., slip ring	2 weeks
1100	50	440/220	900	3	60	Gen. Elec., Slip ring	2 weeks
1198	50	500	550	D.C.	D.C.	Gen. Elec.	1 week

Stock No.	H.P.	Volts	Speed	Phase	Cycles	Make and Type	Shipment
940	50	230	875	D.C.	D.C.	Gen. Elec.	Immediate
1036	40	220/440	900	3	60	Westinghouse, "CCL"	Immediate
1055	40	220/440	900	2	60	Westinghouse "C"	Immediate
1135	40	220/440	900	3	60	Gen. Elec. form "L"	10 days
1083	35	220/440	1200	3	60	Westinghouse, C.S., Sq. Cage	Immediate
797	30	220	1200	2	60	Westinghouse, "C" Sq. Cage	Immediate
971	30	220/440	1200	3	60	Westinghouse "CCL"	10 days
972	30	220/440	1200	3	60	Westinghouse "CCL"	10 Days
1051	25	220	1200	2	60	Gen. Elec. Sq. Cage	Immediate
1124	25	220/440	1200	3	60	Gen. Elec. form KT	Immediate
1125	25	220/440	1200	3	60	Gen. Elec. form KT	Immediate
502	20	220	1800	2	60	Fairbanks-Morse	Immediate
953	20	550	900	3	60	Westinghouse, Sq. Cage, Vertical	Immediate
1108	20	220	1800	2	60	Gen. Elec. K	Immediate
1115	15	220/440	900	3	60	Gen. Elec. Sq. Cage	Immediate
1170	15	220	900	3	60	Gen. Elec. "KT"	Immediate
1169	15	220	900	3	60	Gen. Elec. "KT"	Immediate
1168	15	220	900	3	60	Gen. Elec. "KT"	Immediate
1167	15	220	900	3	60	Gen. Elec. "KT"	Immediate
1166	15	220	900	3	60	Gen. Elec. "KT"	Immediate
1165	15	220	900	3	60	Gen. Elec. "KT"	Immediate
898	10	220/440	1800	3	60	Westinghouse, CS, Sq. Cage	Immediate
1014	10	550	1200	3	60	Westinghouse, CS, Sq. Cage	Immediate
1218	7½	220/440	1800	3	60	Cr. Whlr. Sq. Cage	1 week
1207	7½	115	825	D.C.	D.C.	Gen. Elec. CVC	Immediate
943	7½	220	1750	Single	60	Century	Immediate
1085	5	220/440	1800	3	60	Westinghouse CS	Immediate
1086	5	220/440	1800	3	60	Westinghouse CS	Immediate
1040	5	220/440	1800	2	60	Gen. Elec. "K"	Immediate
1160	5	220	1200	3	60	Gen. Elec. KT	Immediate
1006	5	220	1200	2	60	Gen. Elec. KQ	Immediate
1195	5	440/220	750	3	25	Westinghouse	2 Weeks
512	3	230	1630	D.C.	D.C.	Gen. Elec. CE	Immediate

BELTED ALTERNATORS

Stock 1179 One—300 KW, 440-volt, 450 RPM, 3 phase, 60 cycle, Westinghouse, Revolving Field, three-bearing belted Alternator, complete with field rheostat, belted exciter, pulley and sliding base rails; shipment, two weeks.

Stock 1109 One—200 KW, 2200 volt, 720 RPM, 3 phase, 60 cycle, General Electric, Fort Wayne, Revolving Field type Alternator, complete with field rheostat, exciter, paper pulley and base. Immediate shipment.

Stock 1196 One—100 KW, 220-volt, 900 RPM, 3 phase, 60 cycle, General Electric, ATB, Form B, Revolving Field type Alternator, complete with field rheostat, belted exciter, pulley and base. Shipment, three weeks.

Stock 1110 One—90 KW, 2300-volt, 720 RPM, 2 or 3 phase, 60 cycle, Westinghouse Generator, complete with belted exciter, rheostat, pulley and sliding base rails; shipment, immediate.

DIRECT-CURRENT BELTED GENERATORS

Stock S-966 One—300 KW, 250-volt, 450 RPM, 6 pole, compound wound, direct-current, Westinghouse, three-bearing belted generator (being rebuilt; delivery, two weeks).

Stock 1189 One—75 KW, 250-volt, 875 RPM, Westinghouse, compound wound, type S, direct-current Generator, complete with sliding base rails, pulley and field rheostat. Shipment, two weeks.

MOTOR GENERATOR SETS

Stock 1179A One—300 KW, 250 volts, 450 RPM, direct-current, compound wound Westinghouse generator, complete with field rheostat and direct connected by means of flexible coupling to 450 HP, 440 volt, 450 RPM, 3 phase, 60 cycle Westinghouse revolving field synchronous motor with starter.

TRANSFORMERS

Stock 1199 Three—50 KW, OISC, General Electric, 2200/220 volt Transformers. Shipment, three weeks.

90 WEST STREET, NEW YORK

TELEPHONE, RECTOR 5163-4

SEARCHLIGHT SECTION

IMMEDIATE SHIPMENT

GENERATORS

1—400 K.W. General Electric alternating current, type A.T.B. 2300 volt, 200 R.P.M., 3 phase, with coupling for drive and with pulley for exciter, including one General Electric continuous current, 35 K.W., 125 volts, 1050 R.P.M., Exciter.
1—7½ H.P. Generator, D.C. continuous current, shunt wound, type CO-10, Form A-1042, volts full load 125, 60 amps.
1—2¼ K.W. General Electric Co. D.C. continuous current, type G.E. class 2-2¼-2100, Form A, 125 volts, amps. 18, speed 2100 with pulley.

MOTORS

6—D.C. in sizes from ⅛ to 3 H.P. for 125 volts.
15—D.C. in sizes from ½ to 50 H.P. for 240 volts.
5—A.C. single phase from ½ to 10 H.P.
1—A.C. 3 phase 1¾ H.P.

LINE TRANSFORMERS

350—(Approximately) All in good order, single phase in capacities from 1 to 50 K.V.A. 1100-2200 Prim. 110-220 Sec. Mostly General Electrics, Type H.

ELECTRICAL EQUIPMENT

1—70 K.W. compensator A.C. Western Electric Co. type E 60 B 115 volts, 1075 R.P.M.
20—3 Pole, 300 amp., 2200 volts, G.E. K 6 Oil Switches, with open mechanism, hand operated.
39—3 Pole G. E. Co. K 24, 35,000 volts, 300 amps., Oil Switches, either hand or solenoid operated.
4—12½ K.W. S.P. 2200-4400 volt, potential regulator.
2—1600 K.W., 4400-2200 v., 3 ph., A.B. transformers.
1—30 K.W. 2400 volt, Westinghouse Regulator, No. 645,999, 10% regulation, single phase, secondary amp. 125.
13—Type C-4 Graphic Wattmeters, 30 amp., 220 v., 3 ph.
1—Type C-4 Graphic Wattmeters, 15 amp., 220 v., 3 ph.
1—Type C-4 Graphic Wattmeters, 5 amp., 220 v., 3 ph.
1—Type C-4 Graphic Wattmeters, 200 amp., 125 volt, 2 wire.
2—Type C-4 Graphic Wattmeters, 60 amp., 125 volt, 3 wire.
1—Type C Graphic Voltmeter, 90-130 volts.
1—Graphic Curve Drawing Wattmeter, 400 amp., 220 volt, 3 wire.
1—Graphic Wattmeter, 125 volt, 3 phase.
1—Graphic Wattmeter, 250 volt, 3 phase.
1—Type C P Graphic Wattmeter, 5 amp., 110 v., 3 ph.

MISCELLANEOUS

1—Cochrane open feed water heater, 1750 H.P.
1—National single cylinder, outside end packed, plunger pump 12″ x 8″ x 14″.
1—Union Steam Pump Company boiler feed pump, single cylinder, 7⅝″ x 4¼″ x 9″.
1—Worthington Duplex plunger pump, 6″ x 4″ x 6″.
1—Worthington Duplex plunger pump, with condenser, 7½″ x 10¼″ x 10″.
1—Connersville blower, displacement, per revolution ¾ cu. ft.

THE DETROIT EDISON COMPANY
Detroit, Michigan

IN STOCK
FOR
PROMPT SHIPMENT

60 Cycle Generators

KW.		Speed
1—175	Westinghouse, 3 phase, 2200 volts	900
3—150	Gen. Elec., 3 phase, 220 volts	600
1—75	KVA. Fairbanks-Morse, 3 phase, 230 volts	900
1—90	Gen. Elec., 1 phase, 2300 volt	900
1—85	Allis-Chalmers, 1 phase. 220 volt	900

D. C. Generators

KW		Speed
1—60	Triumph, 250 volts	500
1—75	Ft. Wayne, 250 volts, direct connected to 13x 16 Russell engine	275
1—55	Crocker & Wheeler, 250 volt	930
1—40	Ft. Wayne, 250 volts	975
1—30	Crocker & Wheeler, 125 volt	1150
1—17½	Triumph, 110 volt	750
1— 5	Allis-Chalmers, 125 volt	1800

3 Phase, 60 Cycle Motors

H.P.		Speed
1—100	Gen. Elec., 440 volt, slip ring, type, form M, with controller and resistance.	720
1—50	Gen. Elec., 220 volt	1200
1—40	Gen. Elec., 220 volt	1200
1—30	Gen. Elec., 220 volt	900
1—25	Richmond, 220 volt	750
1—20	Gen. Elec., 220 volt	1200
1—15	Gen. Elec., 220 volt	1200
1—10	Gen. Elec., 440 volt	1200
1— 5	Gen. Elec., 220 volt	1800
1— 3	Gen. Elec., 220 volt	1800

D. C. Motors, 250 Volts

H.P.		Speed
1—25	Crocker & Wheeler	750
1—25	Fisher	500
1—20	Crocker & Wheeler	775
1—15	Triumph	1100
1—10	Browning	1100
1— 5	Triumph	1350
1— 3	Bullock	1050
2— 3	Triumph	1500
1— 2	Triumph	1025

Power Plant Machinery and Accessories

THE RANDLE MACHINERY CO.
1822 Powers St., Cincinnati, Ohio

Chicago House Wrecking Co.

Offer These Snaps For Immediate Shipment From The World's Greatest Stock From Big Purchases

C-461—1—37½ K.W. 125 volt Westinghouse D. C. generator, direct connected to 10″ x 10″ horizontal side crank Russell automatic engine.

K-8—1—125 K.W., 125 Volt D.C. generator, direct connected to Ames Iron Works high speed self-contained engine, 17″ x 16″ cylinder.

K-1—1—125 K.W., 125 volt D.C. type, T.D. continuous current generator, direct connected to DeLaval turbine.

P-19—1105 K.W., A.C., 50 cycle, 3-phase, 2300 volt generator, direct connected to 12″ x 20″ x 16″ Ball engine.

P-20—1—200 K.W., A.C., 60 cycle, 3-phase, 2300 volt generator, direct connected to 18″ x 30″ x 19″ Fleming 4-valve engine.

A. C. MOTORS

Ind. 14—2—15 HP. Fairbanks, 440 volt, 3-phase, 60 cycle, speed 1200 R.P.M.

Ind. 15—2—10 H.P. Fairbanks, 440 volt, 3-phase, 60 cycle, speed 1200 R.P.M.

Ind. 16—1—20 H.P. Fairbanks, 440 volt, 3-phase, 60 cycle, speed 1200 R.P.M. reversing with controller.

Ind. 17—1—7½ H.P. Fairbanks, 440 volt, 3-phase, 60 cycle, speed 720 R.P.M.

D. C. MOTORS

C-404—1—100 H.P. Card Elec. Co., 125 volt, D.C. Motor, speed 675 R.P.M., 600 amperes; compound wound; multipolar type.

Recent purchases of big plants have brought us an unusually large stock of alternating and direct current motors, generators and electrical equipment of every kind. Let us know your needs. Ask for current 128 page Stock List EW-304.

Address **Harris Brothers Co.** Owners
35th and Iron Streets, Chicago, Ill.

SEARCHLIGHT SECTION

1876 The MACHINERY HOUSE OF THE EAST 1917

FRANK TOOMEY, Inc.

NEW MOTORS

For Immediate Shipment

3 phase, 60 cycle, squirrel cage, 220 volt

1—75 H.P. Allis-Chalmers, 900 r.p.m.
3—50 H.P. General Electric "KT" 900 r.p.m.
4—50 H.P. General Electric "KT" 1200 r.p.m.
3—40 H.P. General Electric "KT" 900 r.p.m.
3—40 H.P. General Electric "KT" 720 r.p.m.
1—40 H.P. General Electric "KT" 1200 r.p.m.
1—30 H.P. General Electric "KT" 900 r.p.m.
1—25 H.P. General Electric "KT" 1200 r.p.m.
1—20 H.P. General Electric "KT" 1200 r.p.m.

3 phase, 60 cycle, squirrel cage, 440 volt

2—50 H.P. General Electric "KT" 600 r.p.m.
2—30 H.P. General Electric "KT" 900 r.p.m.
1—30 H.P. General Electric "KT" 1200 r.p.m.
1—25 H.P. General Electric "KT" 1200 r.p.m.

3 phase, 60 cycle, squirrel cage, 440 volt

2—20 H.P. General Electric "KT" 1200 r.p.m.
1—20 H.P. General Electric "KT" 1800 r.p.m.
7—15 H.P. General Electric "KT" 1200 r.p.m.
5—10 H.P. General Electric "KT" 1200 r.p.m.
5—7½ H.P. General Electric "KT" 1800 r.p.m.

Slip Ring, 3 phase, 60 cycle

150 H.P. General Electric form "M" 220-440 volt, 600 r.p.m.
2—100 H.P. General Electric form "M" 220-440 volt, 720 r.p.m.
40 H.P. Crocker-Wheeler, 220 volts, 1200 r.p.m.
35 H.P. General Electric form "M" 220 volts, 1200 r.p.m.
30 H.P. Westinghouse type "CW" 440 volt, 1200 r.p.m.
25 H.P. Crocker-Wheeler, 220 volts, 720 r.p.m.
25 H.P. General Electric form "M" 220 volts, 1200 r.p.m.

127-131 N. Third St., Philadelphia

MOTORS

For Immediate or Prompt Delivery

1/30 to 300 H. P.

Power Transformers
1 to 200 Kva.

Alternators
30 to 300 Kva.

Turbo Alternators

Motor Generator Sets

Rotary Convertors

Engine Generator Sets

Engines

Boilers

Steam & Electrical Machinery Co.
Refer inquiries to Department W.
Bay City, Mich.

Special Prices on These Motors

ALTERNATING CURRENT

H.P.	Make	Phase	Type	Volt	Cycle	Speed	Price
10	Cr.-Wheeler	3		220	60	1800	$160
10	Westinghouse	2	C	220	60	1200	225
10	Gen. Elec.	3	IK	220	25	1500	220
15	Gen. Elec.	3	IK	220	60	1200	275
20	Gen. Elec.	3	IK	220	60	1200	310
22	Gen. Elec.	3	ITC	220 Slip Ring	60	690	400
25	Gen. Elec.	3	IK	220	60	1200	375
35	Gen. Elec	3	IK	220	60	900	500
40	Wagner	3	BP	220-440	60	1200	525
40	Westinghouse	3	HF	220 Slip Ring	25	695	750
50	Westinghouse	3	MW	220 Slip Ring	25	710	875
15	Wagner	1	AC	220	60	1150	275
10	Wagner	1	AC	220	60	1800	175
5	Wagner	1	AC	220	60	1800	140
3	Wagner	1	BA	220	60	1800	100

DIRECT CURRENT

H.P.	Make	Volt	Type	Speed	Price
10	Westinghouse	110	S	1200	$160
10	Westinghouse	220	S	1200	175
10	Gen. Elec.	110	CE	750	190
15	Gen. Elec.	220	CQ	1000	225
15	Gen. Elec.	500	CQ	750	225
15	Gen. Elec.	220	RC	1150	240
20	Gen. Elec.	220	RC	1150	300
25	Northern	125		850	275
25	Gen. Elec.	220	CLB	750	350
60	Western Elec.	110		800 Compound Wound	450
55 KW.	Sprague	125	D	800	525

Monarch Elec. Motor Co.
212 Centre St., New York City
Morris Benjamin, Prop.

SEARCHLIGHT SECTION

NEW MOTORS USED

We carry the largest stock in the East and are prepared to ship almost any requirement instantly from stock.

WE CAN SHIP TONIGHT

any size motor up to 150 H.P. in 3 phase 60 cycle 220 volts, 440 volts or 550 volts.

Our stock of 110 volt, 220 volt and 500 volt direct current motors is complete.

FRANK RIDLON CO.

BOSTON, MASS.

New Copper Wire

FOR SALE

Spot Shipment

No. 2 solid bare	44,000 lbs.
No. 2/0 stranded bare	66,000 lbs.
No. 4/0 stranded bare	13,100 lbs.
No. 4 solid tr. br. W. P.	80,000 lbs.
No. 2 solid tr. br. W. P.	30,976 lbs.
No. 2 str. tr. br. W. P.	13,750 lbs.
No. 1/0 solid tr. br. W. P.	25,604 lbs.
No. 2/0 solid tr. br. W. P.	14,200 lbs.
No. 4/0 str. tr. br. W. P.	4,300 lbs.
No. 1/0 bare	52,552 lbs.
No. 2 bare, stranded	46,453 lbs.
No. 4 bare, stranded	65,228 lbs.

THE MILWAUKEE ELECTRIC RAILWAY & LIGHT COMPANY

Public Service Building

Milwaukee, Wisconsin

FOR SALE

GENERATORS

Qu.	Kw.	Make	Volts	Speed
1	10	Westinghouse	110	1600
1	25	G.E.	600	1800
1	35	C. & C.	250	725
1	45	Westinghouse	120	.....
2	100	Edw.	250	675
1	100	Bullock	110	250
1	75	West. Electric	...	....
1	110	Westinghouse	110	250
1	375	Westinghouse	440	150
1	100	Morgan-Gardner	250	575
1	750	G.E.	440	1800

D. C. MOTORS

Qu.	H.P.	Make	Volts	Speed
1	3	G.E.	110	1100
1	5	Thresher	220	900
1	10	Westinghouse	220	1250
1	25	G.E.	250	675
1	30	G.E.	125	1000
1	45	Holtzer-Cabot	110	515
1	50	G.E.	125	600
1	75	Northern	220	640
2	100	Westinghouse	440	1150

A. C. MOTORS

Qu.	H.P.	Make	Cycle	Phase	Volts	Speed
1	1-12	Electric Vent	60	1	100	3400
1	2	Triumph	60	3	220	1140
1	5	.....	..	..	440	....
1	7½	Westinghouse	..	1	200	....
1	10	Westinghouse	60	3	220	1700
1	75	Allis-Chalmers	60	3	440	725

NATIONAL PRODUCTS CO.

431 Arcade Bldg., East Liverpool, Ohio

We have the following apparatus for *immediate disposal.*

Two 75-kw., 110 and 220 volt

Generators

500 r.p.m.

Two 100-hp., 110 and 220 volt d.c.

Motors

500 r.p.m.

Two 5-kw., 125 volt

Balancer Sets

AMERICAN P. I. COMPANY

48 East 8th Street, New York City

Telephone, Spring 4971-4972

SEARCHLIGHT SECTION

GUARANTEED EQUIPMENTS INSTANT DELIVERY

400—KVA., 3 phase, 60 cycle
400—KVA., 3 phase, 60 cycle, 480 volt, 400 RPM., revolving field Westinghouse belted generator.
75—KW., 3 phase, 60 cycle, 440 volt, 900 RPM., revolving field Westinghouse generator.
2—100 HP., 110 volt, Holtzer-Cabot, D.C. motors, 550 RPM., full commutators.
50—KW., 125 volt, G.E. generator, direct connected to a 13 x 12 Ideal engine, 280 RPM., full commutator.
10—KW., 125 volt, G.E. generator, 555 RPM., full commutator, direct connected to an 18 HP. Metz & Weiss 3 cylinder kerosene engine.
300—KW., 500 volt, D.C., G.E. generator, 400 RPM.
5—150 H.P. Bigelow-Manning Boilers.
1—200 KW., G.E. 3 phase, 60 cycle, 2300 volt generator, Type ATB, Form D, Speed 600, complete with switchboard.
2—100 KW., G.E. 3 phase, 60 cycle, 2300 volt generators, Type ATB, Form D, complete with switchboard.
1—400 KVA Westinghouse, 3 phase, 60 cycle, 480 volts, 400 speed Revolving Field Alternator.

ENGINES

1—18 x 30 x 16 Westinghouse Engine.
1—14 x 13 Armington & Sims Engine.
1—15 x 14½ Armington & Sims Engine.
1—15 x 30 Automatic Fitchburg Engine.
1—13 x 18 Harrisburg Engine.

25 CYCLE MOTORS IMMEDIATE DELIVERY

3—100 H.P. G.E. 550 speed, type K.
1—50 H.P. Allis-Ch. 750 speed, 220 volt, 3 phase, new.
1—50 H.P. G.E. 3 phase, 500 speed, Type K, 220 volt.
2—50 H.P. G.E. 3 phase, 220 volt, 750 speed, Type K.
1—50 West, 3 phase, 220 volt, 730 speed, Type CS, new.
1—25 H.P. G.E. 3 phase, 220 volt, 750 speed, Type K.
2—10 H.P. G.E. 3 phase, 220 volt, 750 speed, Type K.
5—5 H.P. G.E. 3 phase, 220 volt, 1500 speed, Type KT.

DELIVERY IN JANUARY

1—200 H.P. G.E. 3 phase, 220 volt, speed 750, Type K.
1—150 H.P. West. 3 phase, 220 volt, 485 speed, Type C.
1—100 H.P. G.E. 3 phase, 220 volt, 500 speed, Type K.
1—100 H.P. G.E. 3 phase, 220 volt, 750 speed, Type K.
1—60 H.P. G.E. 3 phase, 220 volt, 750 speed, Type K.
3—35 H.P. G.E. 3 phase, 220 volt, 750 speed, Type K.
1—35 H.P. West. 3 phase, 220 volt, 1400 speed, Type CCL.
5—25 H.P. G.E. 3 phase, 220 volt, 750 speed, Type K.
3—20 H.P. G.E. 3 phase, 220 volt, 750 speed, Type K.
1—15 H.P. G.E. 3 phase, 220 volt, 750 speed, Type K.
6—10 H.P. G.E. 3 phase, 220 volt, 750 speed, Type K.
8—5 H.P. G.E. 3 phase, 220 volt, 1500 speed, Type KT.
11—3 H.P. G.E. 3 phase, 220 volt, 1500 speed, Type KT.
6—2 H.P. G.E. 3 phase, 220 volt, 1500 speed, Type KT.

JOSEPH MYERSON 270-8 Commercial St. BOSTON, MASS.

NEW 60 CYCLE MOTORS IN STOCK

TYPE K ROBBINS & MYERS

Bases and Pulleys, Compensator 7-1/2 H. P. and Larger

220 volt, 3 phase, 1750 r.p.m.
One 3 hp. Two 5 hp. Four 10 hp.

220 volt, 3 phase, 1150 r.p.m.
Two 5 hp. Three 10 hp. Two 25 hp.

220 volt, 2 phase, 1750 r.p.m.
Two 1 hp. One 2 hp. Two 5 hp. One 7½ hp. One 20 hp.

220 volt, 2 phase, 1150 r.p.m.
One 3 hp. One 5 hp. One 7½ hp. One 15 hp. One 20 hp. One 25 hp.

DOUBLEDAY-HILL ELEC. CO.

719 Liberty Ave., Pittsburgh, Penna.

POWER MACHINERY EXCHANGE

JERSEY CITY, N. J.

BOILERS

Two 300-hp. Babcock-Wilcox W. T. Boilers with stokers. Insurance certificate, Dec. 1, 1917, for 160 lb. $7,000.
Two 500-hp. Heine with stokers. Insurance certificate, Dec. 1, 1917, for 160 lb. $12,000.

DIRECT CONNECTED UNITS (D.C.)

Kw.	Gen.	Volts	Engine	Price	Kw.	Gen.	Volts	Engine	Price
250	C. W.	250-125	4 valve	$4,500	30	Ridgeway	125	Ridgeway	$900
75	G.E.	250-125	Harrisburg	1,800	30	Sprague	125	Straightline	750
75	G.E.	250-125	Harrisburg	1,800	25	G.E.	250	A. & S.	750
60	Al.-Chal.	250	Watertown	1,200	25	Al.-Chal.	125	Payne	700
60	Al.-Chal.	125	Ames	1,200	20	Northern	125	Ideal	700
50	G.E.	250-125	Harrisburg	1,350	17½	Wghse.	125	Gas-Gasoline	1,000
50	Al.-Chal.	250	Chandler-Tay	1,100	15	C. W.	125	A. & S.	500
40	Al.-Chal.	125	Ames	1,000	3	Diehl	125	Gas-Gasoline	400
37½	Wghse.	250	Skinner	1,100	2½	G.E.	125	G.E. Marine	300
30	Sprague	250	Harrisburg	900					

SEARCHLIGHT SECTION

INDEPENDENT ELECTRIC MACHINERY CO.

CENTRAL STREET AND GOODRICH PLACE, KANSAS CITY, MO.

All Apparatus Listed Actually in Our Stock—Price From 20-40% Below New

220 V. D.C. MOTORS

No.	H.P.	Name	Speed
10	10	Crocker-Wheeler	825
1	10	Ideal	830
1	10	Allis-Chalmers	1200
1	10	Northern	825
1	10	Westinghouse	1150
1	10	Northern	1200
1	10	Amer. Eng.	1200
2	15	Elec. Mch	1050
1	15	G. E. (Crane)	600
1	15	Northern	650
1	20	Crocker-Wheeler	775
2	25	Crocker-Wheeler	750
3	30	G.E. (Vertical)	1500
2	35	Crocker-Wheeler	700
1	40	Northern	1000
2	50	Crocker-Wheeler	625
1	110	Crocker-Wheeler	560

220 V. D.C. GENERATORS

1	15	Natnl. Stamping	900
1	15	W. E.	750
1	25	Peerless	1150
1	25KW	Northern	1000
1	35	Crocker-Wheeler	1750
1	60	Commercial	700
1	60 K.W.	Westinghouse	850
2	70	Westg.	575
1	75	Fairbanks-Morse	750
1	80	Thompson Ryan	600
1	225 K.W.	Crocker-Wheeler R.p.m.	450

110 V. D.C. GENERATORS

No.	K.W.	Name	Speed
7	1¼	Colonial, New	800
1	1½	G.E.	2000
1	1½	R. & M.	1550
1	1½	G. E.	1900
6	3	Colonial, New	800
1	4½KW	Northern	1750
6	5	Colonial, New	800
3	7½	Colonial, New	1200
1	8K W	No-Flicker	1375
4	10	W. E.	1650
2	10	Colonial	1500
2	10	Colonial, New	1200
1	12	W. E.	925
1	15	Phoenix	900
1	22	Phoenix	975
1	30	Northern	650
1	50	Northern	850
1	56¼	Westinghouse	800
1	60	Westinghouse	650
1	75	W. E Eng. Type	275

220 V. D.C. DIRECT CONNECTED SETS

1—25 K.W. 3600 R.P.M., G.E. Direct Connected to Curtiss Steam Engine.

1—50 K.W. Ft. Wayne 275 R.P.M. Direct Connected to Erie City Steam Eng.

1—50 K.W. Northern, 290 R.P.M. Direct connected to Buffalo Forge Co. Engine.

2—75 K.W., 275 R.P.M. Crocker-Wheeler Direct Connected to Harrisburg Fleming Steam Engines.

1—100 K.W., 250 R.P.M. Crocker-Wheeler Direct Connected to Simple Compound Horizontal Bail Engines.

A.C. ALTERNATORS

1—15 K.V.A., 130 V., 3 Ph., 60 Cy., 1800 R.P.M. Wood System.

1—25 K.V.A, 1150 V., 2 Ph., 60 Cy., 1200 R.P.M. Fairbanks-Morse.

1—25 K.V.A., 440 V., 3 Ph., 60 Cy., 1200 R.P.M. Lincoln.

1—50 K.V.A., 2300 V., 3 ph., 60 Cy., 1200 R.P.M., Fairbanks Morse.

1—62½ K.V.A., 3 Ph., 60 Cy., 2300 V., Bullet Generator, 300 R.P.M. Direct connected to Ames Steam Engine. Complete.

1—75 K.V.A., 1 Ph., 60 Cy., 2300 V., 900 R.P.M., G.E.

1—75 K.V.A., 2300 V., 3 Ph., 60 Cy., 900 R.P.M., G.E.

1—100 K.V.A., 3 Ph., 60 Cy., 2300 V., Type A. T. B. G. E., 900 R.P.M.

1—100 K.V.A., 3 Ph., 60 Cy., 2300 V. West. Direct Connected to 145 H.P. Erie City Steam Eng.

1—150 K.V.A., 3 Ph., 60 Cy., 2300 V., 720 R.P.M. Electric Machinery Co.

1—150 K.V.A., 3 Ph., 60 Cy., 2300 V. G. E. Direct Connected to Mansfield Steam Eng.

A.C. MOTORS, SINGLE-PHASE, 60 CY., 110 AND 220 V.

No.	H.P.	Name	Speed
4	¾	Wagner, New	1750
6	1	Peerless, New	1750
4	1	Emerson, New	1750
2	1	Wagner, New	1750
2	2	Emerson, New	1750
9	2	Wagner, New	1750
2	3	Peerless, New	1750
2	3	Wagner, New	1750
2	5	Wagner, New	1750

3 PH., 60 CY., 220 V. AND 440 V.

1	½	Fairbanks Morse	1200
1	½	Fairbanks Morse	1800
4	1	Robbins & Meyers, New.	1750
1	1	Fairbanks Morse	1800
1	1	Fairbanks Morse	1200
1	1	Colonial	1 800
2	1½	G. E.	1200
3	2	Robbins & Meyers, New.	1750
2	2	Westinghouse	580
8	3	R. & M., New	1750
2	3	R. & M., New	1120
10	5	R. & M., New	1750
12	5	R. & M., New	1120
1	7½	R. & M., New	1750
3	7½	R. & M., New	1120
2	10	R. & M., New	1750
2	10	R. & M., New	1120
1	10	F. M.	1200
3	15	R. & M., New	1750
3	15	R. & M., New	1150
4	20	R. & M., New	1150
1	20	R. & M., New	1750
1	30	R. & M. New	840
1	30	Westinghouse	1120
2	30	R. & M., New	1150
1	30	F. M., 2300 V.	1200
1	35	G. E., 2300 V.	1200
1	50	F. M., 220 V.	900
1	50	F. M., 2300 V.	1800

3 PH., 25 CY., 220 AND 440 V

No.	H.P.	Name	Speed
1	1	Ideal	750
2	1	G. E.	1500
1	1	Richmond	1420
1	2	G. E.	750
1	2	Ideal	750
2	2	G. E.	1500
3	3	G. E.	1500
1	3	Ideal	750
4	3	R. & M.	1450
1	5	General Electric	750
2	5	Ideal, New	750
3	5	Ideal, New	1450
5	5	Robbins & Meyers, New.	1400
1	7½	H.P. Ideal, New	720
3	7½	H.P. R. & M., New	1400
1	10	R.& M., New	1400
2	15	G.E.	1500
1	15	R. & M., New	720
2	20	G.E.	1500
3	35	G.E.	1500

ENGINES—GAS, OIL AND STEAM

1—Troy Vertical Steam Engine, Cyl. 7x8, complete.

1—Sampson Steam Engine, Cyl. 8x9, complete.

1—Allfree Steam Engine, Cyl. 10x10, complete.

1—100 H.P. Corliss Steam Engine Cyl. 13x30, Single Eccentric, 100, R.P.M., complete.

1—10x10 Erie City Steam Engine, complete.

2—50 H.P. Olds Oil Engines, Type C, complete.

1—20 H.P. Nash Gas Engine, complete.

1—75 H.P. St. Mary's Gas Engine, complete.

ALL MACHINES ARE REBUILT UNLESS OTHERWISE SPECIFIED

We Have More in Stock — Send for Our Complete List

We carry pulleys, shafting, pumps and everything in the Electrical Merchandise Line. Call on us.

FOR SALE

LIQUID AIR

Shipped in our own containers which are loaned to the customer. Price $3.50 per litre; in quantities of 2 litres or more $3.00 per litre.

Delivered by Special Messenger to any Railway station.

DE FOREST RADIO TEL. & TEL. CO.
1391 Sedgwick Avenue, Bronx
New York City, N. Y.

Motors—Dynamos

Hp.	Speed	Ph.	Cy.	Volts		Price
60	850	3	60	220 or 440	complete	$575
60	850	3	60	220 or 440	slip ring	675
30	685	3	60	220 or 440	C. S. Westgh.	
15	850	3	60	220 or 440		225
10	850	3	60	220		195
3	850	3	60	220		70

15 new back-geared a.c. motor.
15 back-geared, 220 v. d.c. Gen. Elec.
70 220 volt C. L. B. Gen. Elec., 800 speed motor.

Instruments, circuit-breakers, oil switches, etc., in stock. Entire plants or parts bought and sold.

R. SCHEINERT CO.
125 N. 3rd St., Philadelphia, Pa.

D-C. MOTORS, 220-VOLT

For Immediate Delivery

Due to the completion of a munition contract, we have for sale the following list of motors, which are in good condition:

8—1 hp. General Electric, 1150 R.P.M.
1—1 hp. General Electric, 1700 R.P.M.
1—3½ hp. C. & C. Electric C., 1200 R.P.M.
1—7½ hp. C. & C. Electric Co., 1300 R.P.M.
1—7½ hp. Stanley Electric Co., 980 R.P.M.
1—7½ hp. Allis-Chalmers, 875 R.P.M.
1—10 hp. Allis-Chalmers, 825 R.P.M.
1—10 hp. Allis-Chalmers, 500 R.P.M.
1—15 hp. Allis-Chalmers, 800 R.P.M.
1—15 hp. General Electric, 625 R.P.M.
1—20 hp. C. & C. Electric Co., 975 R.P.M.
1—20 hp. Allis-Chalmers, 575 R.P.M.
Also 1—2 hp. General Electric, 1500 R.P.M. a.c., 220 volt, 3 phase, 25 cycle Motor.
Also 1—Westinghouse Transformer, 3 phase, 250 K.V.A. with 2 Switchboard Panels, including 1 General Electric Co. Voltmeter and 1 Westinghouse Watthour Meter.

GENERAL RAILWAY SIGNAL COMPANY
Rochester, N. Y.

Agency Wanted

Experienced mechanic and electrical engineer in the liveliest town in Texas wants the agency of manufacturers. Address Box 3421, Elec. World.

"Well satisfied—

Shall use the

SEARCHLIGHT SECTION

Whenever I need more publicity"

Do *you* need publicity?

81

SEARCHLIGHT SECTION

The Power Plant located at Glen Eyrie, Colorado Springs, Colo., is being dismantled and the following list of machinery offered for sale, by the owner

The plant was built without any limitation on the cost and all of its equipment is the best. It has had very little use and has received expert care and attention at all times

150 H.P. Cahall Horizontal Sectional water tube boiler containing nine sections of 9 tubes each 4" in diameter and 16 ft. long.

Stoker for 150 H.P. Boiler.

100 H.P. Cahall Horizontal Sectional Water Tube Boiler containing 7 sections of 9 tubes each 4" x 16 ft.

Stoker for 100 H.P. Boiler.

(1) 10 H.P. Vertical Steam Engine for driving stokers.

The above stokers and boilers were manufactured by the Aultman & Taylor Co., at Mansfield, Ohio, and are in first class condition.

(1) Blow off tank for Boilers.

(1) 4' x 2' 1½ ft. Truax Ore Car with pedal for dumping.

(1) 5½ ft. x 2' 9" Coal Car with one side as door cap. 1 ton. Mfg. by C. W. Hunt & Co., N. Y. C.

(1) Cochrane special feed waterheater and receiver. Mfg. by Harrison Safety Boiler Works, Phila., Pa. Size 6' x 26". Outside 10" inlet and dis.

(2) Worthington Boiler feed pumps, Brass lined and Brass rod. No. 200,407 6 x 4 x 6. No. 200,046 ditto.

(1) Cochrane Live Steam Separator for 5" pipe. Mfg. Harrison Safety Boiler Works.

(1) Exhaust and live steam Water Heater. Mfg. National Feed Water Heater Co., New Haven, Ct. No. 9577, 9' long 5' dia., outside wood and asbestos covered.

(1) Fan for forcing draft on Boilers, has 21" opening for air suction (Boiler Cap 250 H.P.).

Western Electric D. C. Motor now direct connected to boiler draft fan. Type E. R. 3 A, No. 22205, Volts 240/250 Amps. 14.1, H.P. 5½, 850 to 1000 R.P.M., equipped with starter.

(1) DeLaval Steam Turbine with reduction gear mounted on extended base and direct connected to DeLaval Centrifugal pump. Pump No. 3046, Type I.P. 6, Steam press 80 speed 2400. 92.5 ft. Hd. 400 gallon min.

(1) DeLaval Anc. centrifugal pump direct connected to D.C. Motor on ext. base pump No. 3047, 92.5 ft. Hd. 400 G.P.M. Type L.M.P. 6 speed 20 50 Pump only.

(1) 8 x 9 Chuse Engine No. 596. Generator connected, listed.

(1) Phoenix Automatic Oil filter No. 2756. Mfg. at Racine, Wis.

(1) Automatic Johnson water Temp. regulating valve.

(1) National Crown Water meter.

(1) 3" Steam trap.

(1) Pressure Red. Valve.

(1) Steam Trap. Mfg. by Steam Specialty Co. ¾" pipe.

(1) Shelsa Clock, 9" Dial, Brass case.

(2) 7" dial Ashcroft Vac. Company Press gauges. 30-0-60 range.

(1) 7" dial Aashcroft Steam Pressure gauge, 0-26-.

(4) Recording Bristol Pyrometers, 8" face.

(1) 6" Venturi meter tube for measuring water flow, No. 408, 3" throat.

(1) Ashcroft Altitude gauge 0-140 range.

(1) 7" Flange gate valve, 11" volt circle, 8 holes, 12½" flange. Mfg. Nelson Valve Co.

(1) Goulds Triplex Pump figure 934, size 2½ x 4, No. 560, direct connected to 3 K.W. Edison bi-polar D. C. Motor 250 Volts, No. 844.

(2) 4" gate valves 7" flange, 6" bolt circle, 8 holes.

(1) Power Plant Switch Board—two panel, each slab 4' x 8' marble board contains:

1 Whitney Battery Ammeter 0-100 A.
1 Whitney Battery Voltmeter 0-300 V.
1 Whitney ammeter for generator 0.100 A.
1 Whitney voltmeter for generator 0.300 V.
1 Whitney ammeter 0.200 A.

All above instruments mounted in brass case with 8" face 4 Cutler-H. field rheostats, 3 continuous curve drawing Weston Wattmeters. No. 90900. Type C. Volts 250, A. 100.

1 Thompson recording Wattmeter No. 841466, Am. 100 V. 250.

1 ditto No. 312984.

2 circuit breakers I. T. E. No. 3321, Amps. 100, V. 250.

MOTORS

(1) Variable speed B. F. Sturtevant Co., D. C. motor direct connected to B. F. Sturtevant fan, Type M.P. 4 size 10 Form P No. 2741, Volts 220, Amps. 18, Min. R.P.M. 200, Max. R.P.M. 330 with 170 Ohms inserted in field circuit, complete with starting box.

(1) New Armature for above motor, never used.

(1) Holtzer-Cabot D. C. Motor Type E, size 1 H.P., Volts 240, Amps. 4.35, Speed 1175, No. 15340, equipped with sliding base 24 x 2½", pulley and starting box.

(1) Crocker-Wheeler D. C. motor, size 7.5 F. Type C.C.M. 4.75 H.P. at R.P.M. 220 Volts. 18.8 Amps.

No. 2035 Code No. 39737, equipped with sliding base and automatic starting device.

(1) Crocker-Wheeler D. C. Motor, size 10, Type C. C. M., 6½ H.P., 550 R.P.M., No. 1144, Volts 230 Amps. 25, equipped with sliding base 9" x 8" wood pulley and starting box.

(1) Crocker-Wheeler D. C. Motor, size 1 C. C. M., 65 H.P., No. 3131, Volts 230, Amps. 27, speed 650, with starter and sliding base.

(1) Western Electric D. C. Motor now direct connected to boiler draft fan, Type E. R., 3 A., No. 22205, Volts 240/250, Amps. 14.1, H.P. 5½, 850 to 1000 R.P.M., equipped with starter.

(1) DeLaval D. C. Motor direct connected to Centrifugal pump of same make. Motor No. 3057. Type J.M.P. 6 speed 2050, 70 amps., 240 volts, equipped with starting box.

(1) Booster Set, Direct connected with flexible coupling, mounted on extended base Western Electric. Motor: E2AOB No. 32389, 220 Volts, 1480 R.P.M. Generator: Type E3 No. 32846, 1480 R.P.M., 60 Amps. full ld., Volts 60.

(1) Westinghouse D. C. Generator, 25 K.W., 250 volts, 100 amps., 325 R.P.M. Serial No. 389063. This generator direct connected to 8 x 9 Chuse engine. Engine listed.

(1) New England D. C. Generator, Class M. E. 15, 230 V., 44 Amps. Speed 750, on slide base.

(1) New England motor, class M. E. 10, Volts 230, Amps. 31, 780 R.P.M., on slide base.

(1) Crocker-Wheeler ½ H.P., C. M. Style No. 2003, 1200 R.P.M., 2.2 A 230 Volts, Bi-polar.

(1) Edison G. E. Bi-polar, 6 K.W. 250 V.

(120) Chloride Accumulator cells size F.

(120) Chloride Accumulator cells size E.

(14) Chloride Accumulator cells size D.

(20) Chloride Accumulator cells size B. All above cells made by Electric Storage Battery Co. at Phila., Pa.

(1) Charge outfit for B. & B. cells as follows: Crocker-Wheeler, size ½ L Generator, Type S. E. C. D., speed 1880 X 1 5%, 160 W. 210 W 8 A., No. 641, Code No. 44620.

(1) Crocker-Wheeler motor direct connected to above type C. M. No. 640, Volts 240.

(1) Switch board for the B. & D. battery charging outfit consisting of Ammeter Voltmeter, starting box and field regulator and 6 double pole double throw switches, Field Regulator in No. 2915, 8000 Ohms, 16 K.W. 240 Volts.

(1) Thompson Recording Wattmeter No. 852118, 100 A, 250 Volts.

(1) Switch Board connected to power plant for charging C. and F. cells designed by C. O. Maillouse, N. Y. C., contains:

1 Whitney Ammeter 0 to 200.
1 Whitney Voltmeter 0 to 300.
1 Whitney Ammeter 50 to 50.
1 Whitney Ammeter 100 to plus 100.
1 Automatic Voltage regulator operated by 1/6 Horse Power C. W. Motor.

(1) Edison Ammeter 0-20.

(1) Direct reading Edison Voltmeter No. 255, 200-250.

LAUNDRY MACHINERY

(1) Mangle Mfg. by Troy Laundry Machinery Co., 3 rolls 16" dia. x 8 ft. long, and 1 large heating drum 8 ft. long. N. 75.

(1) All Brass Washer. Mfg. Troy Laundry Co., inside dimensions 46" long x 31" dia.

(1) Extractor. Mfg. by Troy Laundry Co. 41 Limit, 82 Bowel opening 18" Depth 12".

(3) Gal. iron clothes carts 35" x 20" with drain holes in bottom and mounted on 2 wheels at center with balance wheel at each end.

(1) Crocker-Wheeler D. C. Motor, size 3F, type C. C. M. 3 H.P. at 1000 R.P.M., 230 V. 12.2 Amps., No. 1799, Code No. 36977. Complete with starting box. Armature turned down once. Used to drive extractor in laundry.

(1) 15" x 15" Copper jacket starch cooker.

(1) Improved sectional dry room 6½ x 8' x 8', 2 doors, 3 sets steam coils, 3 drying racks with 3 shelves each.

(1) Shunt wound G. E. Motor Type C. A. Class 2, ½ H.P., 1400 R.P.M., 215 amps, 230 volts, No. 92103, Form B, with starting box and 3½ x 4 Pulley.

(3) Troy ironing board stands, No. 264, 265, 266.

(3) Electric Irons, 230 volts, 2 to 2.2 amps.

(1) Water filter to filter laundry water. Mfg. by Loomis-Manning Filter Company, No. 2880, made in two sections 8' long, 2' diameter.

MINING MACHINERY

Hoist and core drill.

THE GLEN EYRIE DEVELOPMENT CO.

Colorado Springs, Colo.

SEARCHLIGHT SECTION

NATHAN KLEIN & COMPANY OF NEW YORK

OFFERS THE LARGEST STOCK **MOTORS** EITHER WAY, BUY—SELL RENT—EXCHANGE

This is only a partial list of what we have on hand, and others continually coming in:

SLIP RING MOTORS

Qu.	H.P.	Make	Ph.	V.	Speed
1	150	W.E.-G.E.	3	440	720
1	75	Whse.	3	440	900
1	50	Whse.	3	220	1800
1	40	Whse.	3	220	580
3	30	Whse.	3	220	1150
1	20	Whse.HF.	3	220	690
1	20	Whse.	3	220	840
2	15	Whse.	2	220	900
1	11	Whse.	2	220	1110
1	10	Whse.	2	220	600
1	10	Whse.	2	220	1700
1	3	G.E.	3	440	1200
1	2	Richmond.	3	220	690

A.C. 25 CYCLE

2	½	R. & M.	3	220/440	1400
3	7½	G.E.	?	440	1500
1	15	Fbs.Mse.	3	220/440	710
1	15	G.E.	3	220/440	1500
1	20	G.E.	3	220	1500

A.C. 3 PHASE

Qu.	H.P.	Make	Volts	Speed
1	200	W.E.	2200	870
1	150	Whse.	2200	700
1	150	G.E.Vert.	220	600
1	100	Whse.	550	900
1	75	Whse.	220	850
1	75	G.E. new.	220	900
1	75	G.E. new.	1200	
1	70	Lincoln, new.	440	1800
2	50	G.E.	220	900
1	50	Whse.	220	1200
1	50	Allis-Chlms.	220	860
3	50	Whse.	220	850
1	50	Whse.	220	720
		Sq. Cage		
1	50	Whse.	220	720
		Slip Ring		
3	50	G.E.	440	900
1	50	G.E.	220	1200
1	40	Allis-Chlms.	220	860
1	40	Allis-Chlms.	220	1200
1	35	G.E.	2200	1200
1	35	G.E.	220	900
2	25	G.E.	440	720
1	25	Mech. App.	220	1200
1	25	Allis-Chlms.	220	860
1	25	Fbks.	220	1200
3	20	G.E.	220	1200
1	20	Whse.	220	1700
1	20	Allis-Chlms.	220	860
1	20	Watson.	220	1200
1	20	Whse.	2200	1200
3	20	Whse.	220	690
2	20	G.E.	220	900
3	20	Whse.	220	850
1	15	W.E.	220	685
1	15	W.E.	220	1200
3	15	G.E.	220	720
1	15	Whse.	220x3	720
1	10	W.E.	220	1800
1	7½	G.E.	220	1500
3	7½	G.E.	220	900
2	7½	G.E.	220	1200
4	5	G.E.	220	1700
4	4	G.E.	220	1200
14	3	G.E.	220	1700
12	3	G.E.	220	1200
15	½	G.E.	220	1800
4	1	Whse.	220	1700

A.C. 2 PHASE

2	50	Whse.	2200	1700
1	30	Whse.	220	1120
1	20	W.E.	220	1125
1	20	Whse.	220	1700
4	20	G.E.	220	1200
2	15	Whse.	220	850
1	15	Whse.	220	1120
3	15	G.E.	220	1200
3	15	Whse.	220	1700
2	15	Wagner	220	1700
2	10	Whse.	220	850
3	10	G.E.	220	1200
2	10	Whse.	220	1700
1	10	G.E.	220	720
1	7½	Richmond.	400	1740
2	7½	Whse.	220	850
2	7½	Whse.	220	1200
1	7½	G.E.	220	720
6	5	G.E.	220	1700
2	5	Whse.	220	450
6	3	G.E.	220	1800
8	2	G.E.	220	1800

A.C. SINGLE PHASE

1	30	Wagner	220	1150
1	15	Wagner.	110/220	900
2	7½	G.E.	60	1750
1	7½	G.E.	60	1150
3	5	Century.	220	1700
2	5	Wagner.	220	1700
8	5	G.E.	110/220	1800
142	¼	Whse.	110	1700
32	¼	Emer. new.	110	1750
60	⅛	Whse.	110	1700

D.C. 110 VOLTS

Qu.	H.P.	Make	Speed
1	75 KW.	Westg.	800
1	35	C. & C.	800
1	30	Siemens Halske.	1000
1	30	Eddy	800
2	30	Siemens Halske.	1000
1	30 KW.	G.E.	720
1	25 KW.	G.E. NEW	900
15	¾	H.C.	1700
1	15	G.E.	450
2	15	W.E.	1100
1	15	C. & C.	750
1	15	G.E.	1200
1	12	W.E.	1000
1	10	Roth	900
2	10	G.E.	1100
1	8½	W.E.	1150
1	7½	Watson.	1525
5	½	H.C.	1100
2	5	G.E.	1100
5	3	G.E.	1100
2	3	G.E.	1625
2	2 KW.	G.E. 50V.	515

EXHAUSTFANSWITHA.C.&D.C.

50 18-inch Exhaust Fans
3 36-inch Exhaust Fans, 110-220 v.
2 42-inch Exhaust Fans, A.C. & D.C.

D.C. 220 VOLTS

1	60	Sturtevant.	427/495
1	40	C. & C.	750
1	35	G.E.	675
1	35	C. & C.	600
1	35	C. & C.	900
1	30	G.E.	800
1	25	Spr.	750
1	25	G.E.	635
1	25	G.E.	1200
2	25	G.E.	675
2	20	G.E.	750
2	20	G.E.	1100
1	20	Sprague.	850
1	20	Allis-Chlms.	600
1	15	Diehl.	925
1	15	C. & C.	1125
1	15	Whse.	1675
1	15	G.E.	1000
1	15	Hltz. Cbt.	700
1	10	Reliance.	1400
1	10	G.E.	1100
1	10	Allis-Chlms.	800
1	10	G.E.	450
1	10	Stand.	1225
2	10	G.E.	450/900
2	10	C. & C.	1100
2	10	Whse.	1750
1	7½	W.E.	500/1500

D.C. 500 VOLTS

1	100	Whse.	700
1	50	C. & C.	425
1	50	Whse.	1700
1	30	C. & C.	350
1	30	G.E.	750
1	20	C. & C.	1120
1	20	C. & C.	1100
1	15	C.W.	1200
1	15	G.E.	1200
1	15	G.E.	1800
1	10	Stand.	1375
1	10	G.E.	650/1950
6	10	G.E.	450/900
1	7½	G.E.	650/1900
1	50Kw.	G.E., 550 v., D.C.	600

PLATING DYNAMOS

2—1000 Amp. Plating Dynamos
1—3000 Amp. Plating Dynamo
1— 400 Amp. Plating Dynamo

BOILERS (In Stock)

WATER TUBE

1—300 H.P. Heine—Plain Grates.
4—275 H.P. Heine—Wetzel Stokers.
1—250 H.P. Heine—Wetzel Stoker.
1—250 H.P. Heine—Murphy Stoker.
2—264 H.P. Babcock & Wilcox.

FIRE TUBE

1—96″ x 19′ 7″ Horizontal Tubular Suspended Type.
2—72″ x 18′ Horizontal Tubular.
1—80 H.P. International "Economic."

MARINE TYPE

2—10′ x 10′ Scotch (wet back).

H. P. BREARLEY
90 West Street, New York City

For Sale for Prompt Shipment

1—50 H.P. 3 phase	1—150 H.P. 2 phase slip ring
1—40 H.P. 3 phase	1—100 H.P. 2 phase slip ring
4—35 H.P. 3 phase	1— 75 H.P. 2 phase slip ring
5—25 H.P. 3 phase	1—150 H.P. squirrel cage
4—10 H.P. 3 phase	10— 30 H.P. squirrel cage
3— 5 H.P. 3 phase	10— 35 H.P. squirrel cage
	8—25 H.P. squirrel cage
	4—20 H.P. squirrel cage

If there is anything you do not see on this list, write us; we can supply you with same. We have 3000 to select from in our warehouse.

VENINO BROTHERS & CO.
65 Hamilton Street, Newark, N. J.

New Jersey's Electrical Clearing House

Motors for Immediate Delivery

A. C., 60 Cycle

4—50 HP., 2 phase, 220 V., 900 RPM., Fairbanks-Morse.
1—30 HP., 3 phase, 220 V., 900 RPM., General Electric.
3—30 HP., 2 phase, 220 V., 900 RPM., Fairbanks-Morse.
8—20 HP., 2 phase, 220 V., 1200 RPM., Fairbanks-Morse.
2—20 HP., 2 phase, 220 V., 1200 RPM., Westinghouse.
1—20 HP., 2 phase, 220 V., 1200 RPM., Westinghouse slip ring.
1—20 HP., 2 phase, 220 V., 685 RPM., Westinghouse.
8—15 HP., 2 phase, 220 V., 1200 RPM., Fairbanks-Morse.
1—10 HP., 2 phase, 220 V., 1100 RPM., Wagner slip ring.
2—25 HP., 2 phase, 220 V., 1200 RPM., Fairbanks-Morse.
1—50 HP., new 230 V., D. C., 525 RPM., 195 Amp., series wound Crane motor, No. 22216, General Electric Co.
100—Fairbanks-Morse ½ HP. up to 10 HP., inclusive, 2 phase, 60 cycle, 220 V., motors new, at bargain prices.
1000 other motors from 1/30 HP. up, D.C. and A.C., all voltages, speeds and makes.

BROWN-HUNKELE CORPORATION
12 Mechanic Street **Newark, N. J.**

We are constantly in the market for large generating units, motors, etc.

WE MAINTAIN THE

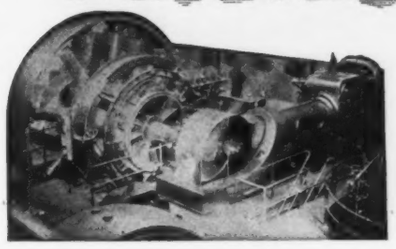
Largest Electrical Repair Plant in the United States and Rebuild and Overhaul All Types of Electrical Apparatus

I. R. NELSON, 1 Bond Street, Newark, N. J.

SEARCHLIGHT SECTION

PAUL STEWART AND COMPANY

FIRST NATIONAL BANK BLDG. ELECTRIC AND STEAM MACHINERY CINCINNATI, OHIO U.S.A.



INVALUABLE assistance furnished in meeting your requirements for dependable electrical and steam power apparatus in first-class condition. Wire your needs NOW. Prompt attention to inquiries. Immediate deliveries.

500 K. W. Unit

600 K.W. (800 K.W. capacity) 250 Volt Direct Current G.E. Generator, dir. conn., 90 RPM. to Cross Compound heavy duty American Wheelock, Switchboard and Condenser.

Motor

1200 HP. General Electric, 25 Cy., 3 Ph., 2300 V., 250 revolutions with control panel and controller. Immediate shipment.

Alternators

3—800 K.W. General Electric, 60 Cy., 3 ph., 2300 V. Revolving Field Alternators, dir. conn. to Cross Compound heavy duty Engines.

1—300 K.W. General Electric, 60 Cy., 3 Ph., 2300 V., 450 RPM., 3 Bearing Type Belted Alternator with Panel and Belted Exciter. Immediate shipment.

1—312 K.V.A. Allis-Chalmers Revolving Field, 60 Cycle, 3 Phase, 440 or 2300 Volts, direct connected to Erie Ball Heavy Duty Engine, Exciter and Panel.

Boilers

2—600 HP. B. & W. type steel header, code built, 200 lb. working pressure Water Tube Boilers with superheaters and Rooney Stokers.

3—550 HP. Stirling Water Tube, 160 lb. boilers. Hand fired.

1—512 HP. Stirling high pressure, code built, Water Tube Boiler, 175 lb. allowance complete with Rooney Stoker.

1—350 HP. B. & W. steel header, code built, Water Tube Boiler, 155 lb. allowance complete with Rooney Stoker. Stack and all Fittings.

2—260 HP. B. & W. Steel Header, code built, 175 lb. allowance with chain grate stokers.

1—400 HP. Heine, code built, 160 lb. boiler with Hawley Down Draft furnace.

Paul Stewart & Company

First National Bank Bldg. **Cincinnati, Ohio**

New Motors—General Electric

IMMEDIATE SHIPMENT

3 Phase, 60 Cycle, 220-440 Volts.

Stock	H.P.	R.P.M.	Type	Form
30	5	1200	Squirrel cage	K.T.
30	7½	1800	" "	"
10	7½	900	" "	"
10	10	1800	" "	"
20	10	1200	" "	"
10	10	900	" "	"
15	15	1800	" "	"
20	15	1200	" "	"
10	15	900	" "	"
5	20	1800	" "	"
10	20	1200	" "	"
10	20	900	" "	"
10	25	1200	" "	"
5	25	900	" "	"
6	30	1200	" "	"
15	30	900	" "	"
6	40	1800	" "	"
5	40	1200	" "	"
10	40	900	" "	"
3	50	1200	" "	"
6	50	900	" "	"
3	50	600	" "	"
1	75	1800	" "	"
3	75	900	" "	"

3 Phase, 60 Cycle, 440 Volts.

			Type	Form
1	100	720	Squirrel cage	K.T.
1	100	900	" "	"
2	150	600	" "	"

3 Phase, 60 Cycle, 220-440 Volts.

1	25	1200	Slip ring	M
8	35	900	" "	"
4	35	1200	" "	"
3	50	1200	" "	"
2	75	900	" "	"
1	125	450	" "	"

All motors listed are strictly new, in original crates, each complete with pulley, base and compensator or drum controller. Many sizes are available. Send me your inquiry if you require any other sizes 60-cycle motors.

R. J. KIRCHNER

823 Dime Bank Building, Detroit, Michigan

Turbo-Generator Plant with Buildings

2—2500 Kw. A.C., G. E., Vertical Turbo Generators, 3 ph., 2200 V., 750 R.P.M. Complete condensers; rotary converters; switchboard equipment. All equipment for complete plant with Heine Boiler, 200 lb., with steam mains and complete piping for above plant with all auxiliaries; complete steel building for same.

New

1—1000 Kw., 60 cy., 3 ph., 2300 V. Turbo Generator, complete with condenser and switchboard.

1—5000 Kw., 60 cy., 3 ph., 2300 V. Turbo Generator, complete with condenser and switchboard.

Boilers

9—450 HP. Stirling, 190 lbs.

4—350 HP. B. & W., 160 lbs.

1—450 HP. Edge Moor, 160 lbs.

SUN POWER EQUIPMENT CO.

417 Commercial Trust Bldg.

Philadelphia, Pa.

SEARCHLIGHT SECTION

A.C. DIRECT CONNECTED UNIT FOR SALE

1—60 KVA Ridgeway Rev. Fld. Alternator, 3 Phase, 60 Cycles, 2300 Volts, 15.1 Amps., 300 RPM—direct connected on cast iron sub-base to 1—12 x 12 Ridgeway Automatic Engine, complete with 1—5 KW Thompson-Ryan exciter, 40 Amps., 110 Volts, 1200 RPM. Also two panel switchboard equipped with A. C. and D. C. instruments, exciter switch, synch. receptacles, rheostat, pilot lights, series and potential transformers, field discharge resistance and oil switch.

This unit is ready for prompt delivery. Owned and offered by

THE FUERST-FRIEDMAN CO.
CLEVELAND, OHIO

WANTED IMMEDIATELY

Three 1000-2000-kw., 250-volt, direct-current, direct-connected

Turbo Generating Units

or will consider engine-driven units having aggregated capacity of 5000 kw. Describe with full engineering report as to condition, delivery, together with lowest cash price.

GOLDEN HILL DISTILLING CO.
139 East Town St.
Columbus, Ohio

300 KW ROTARY CONVERTER SET FOR SALE

Consisting of 300 KW Westinghouse Rotary, 3 Phase, 60 Cycles, 900 RPM, complete with 3—100 KVA Westinghouse Oil Cooled Transformers, 2200 Volts primary, rotary voltage secondary. Direct Current End 250-275 Volts, 1200 Amperes. Outfit complete with Primary A. C. Panel, Starting Apparatus and Direct Current Switchboard with Instruments, etc.

This outfit can be delivered between 60 and 90 days and can be seen running. Owned and offered by

THE FUERST-FRIEDMAN CO.
CLEVELAND, OHIO

IMMEDIATE DELIVERY

NEW

375 K.V.A. TURBINE

General Electric Curtis horizontal Turbo Generator unit, 480 volt, 60 cycle, 3 phase, 375 K.V.A., 300 KW 80% P.F., 3600 R.P.M. Non-condensing 140 lbs. steam pressure. Can use superheat up to 125 degrees F. Direct connected exciter and Generator Panel. This machine is absolutely new, never unboxed. Can be inspected near Detroit, Mich.

R. J. KIRCHNER
823 Dime Bank Bldg., Detroit, Michigan

MOTORS

NEW GENERAL ELECTRIC 3 PHASE SIXTY CYCLE

H.P.	Speed	Volts 220	Volts 440	
*150	600		1	Del. Jan. 12
**100	720	1		
100	900	1		Del. Feb. 23
75	720	1		Del. Dec. 18
75	900	1		Del. Dec. 18
50	720	1		Del. Dec. 18
50	900	2	2	
40	720		1	
40	900	3	5	
40	1200	1	1	
30	900	1	1	
30	1200	1	2	
25	900		1	
20	900	1	1	
20	1200	2	4	
15	900	1	1	
15	1200	2	6	
15	1800	2		Del. Dec. 21
10	900	3	2	
10	1200	12	7	
10	1800	2		Del. Dec. 21
7½	900	3	1	
7½	1200	1	2	
7½	1800	3	1	
5	900	1		
5	1200	2		Del. Dec. 21
5	1800	1	1	
3	1200	2		
3	1800	5		
2	1200	3		
2	1800	4		
1	1200	3		
1	1800	11		
1	1800	(110 V.)—1		

*Slip Ring.
**In Transit.

Practically all 220 volt motors listed can be changed to 440 volt or vice versa.

ELLIOTT ELECTRIC COMPANY
322-324-326-328 Champlain Ave., Cleveland, Ohio

IMMEDIATE SHIPMENT

2—600 KW., 2300 V., 60 Cy., 3 Ph., G.E. steam turbo units, with Worthington surface condensers.
1—300 KW., 80% PF., 2300 V., 60 Cy., 3 Ph., Westinghouse turbine, with condenser, exciter and auxis. Used about one year.
1—250 KW., 240 V., Kerr-Economy-Allis 3600 Rev., 3 Ph., mixed pressure turbine, with surface condenser and aux. Used about six months.
2—265 HP., B & W boilers, steel headers, 175 lb. with B & W stokers.
1—600 H.P. Stirling boiler, 200 lb. B & W stokers, superheater. Used about six months.
4—NEW 440 HP. B & W boilers, 250 lb. with superheaters.
1—each 40, 50, 75, 100, 125 HP., 3 Ph., 900-1200-1800 RPM., motors 220-440-2200 V:
2—72" x 18' H.R.T. boilers, 125 lbs. with stacks.
1—60" x 16' H.R.T. boiler, no stack.
2—72" x 21' H.R.T. boilers, 125 lbs., stacks.

ROSS POWER EQUIPMENT COMPANY
617 Merchants Bank Building, Indianapolis, Indiana

INSTANT SHIPMENT

SYNCHRONOUS MOTORS

2—150 HP., 3 Ph., 60 Cy., 2300 Volt General Elect. 900 RPM Type ATI, Form PB Self Starting with Direct Conn. Exciters, Bases and Pulleys, Self Contained Compensators and Switchboard.

MOTOR GENERATORS

100 Kw., 250/275 Volt Ridgway 3 Ph. 60 Cy. 2300 Volt 1200 RPM Synchronous Set with 2 Panel Switchboard.
75 Kw., 250 Volt Milwaukee coupled to 100 HP. 3 Ph. 60 Cy., 440 V. General Elect. Motor with Compensator and Switchboard.

ALSO
A LARGE STOCK OF AC AND DC MOTORS AND GENERATORS

MILLER-OWEN ELECTRIC CO., Inc.
Pittsburgh, Pa.
Pittsburgh's Electrical Clearing House

Sold

Air Compressor for Sale

One 14—8½ x 12 high speed air compressor. Motor driven. Never been used. Built by the Norwalk Iron Works. Williamsport Wire Rope Company, Williamsport, Pa.

What Have You to Sell?

"Kindly discontinue our advertisement as Compressor has been sold through this advertisement."

L. CUNNINGHAM,
Purchasing Agent

Above ad cost only $1.50 an insertion and was published but five times. This is only one example among many of the selling power of the WORLD'S Searchlight Section.

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SEARCHLIGHT SECTION

IMMEDIATE SHIPMENT

DIRECT CURRENT MOTORS—220 TO 250 VOLTS

No	H.P.	R.p.m.	Wdg.	Type	Make
1	⅙	1500	Cp.		R.& M.
1	¼	1125	Sh.		Nwest.
1	½	1800	Sh.		Peerless
2	½	550/700	Var.	CM	Cr.Wh
1	1	1500	Sh.	CCM	Cr.Wh.
1	1	1700	Sh.	R	Westghse
2	1½	1200	Sh.		Thompson Elec.
1	1½	1200	Sh.	B1	Milwaukee
1	1½	785	Sh.		Northwestern
1	1	1750	Sh.		G.E.
1	2	1600	Sh.		G.E.
1	2	1600	Sh.	CCM	Cr.Wh.
1	2	1180	Sh.		Northwestern
1	2	1150	Sh.	CM	Cr.Wh.
1	2	1150	Sh.	RC	G.E.
1	2	1100	Sh.	CVC	G.E.
1	2	900	Sh.	R	Wstghse
1	3	1650	Sh.	CE	G.E.
1	3	1600	Sh.	R	Westghse.
1	3	1100	Sh	CVC	G.E.
2	3	1000	Sh.	CM	Cr.Wh.
1	3½	900	Sh.	MP	Peerless
1	5	1700	Sh.	CVC	G.E.
1	5	1870	Sh.		G.E.
1	5	950	Cp.		Westghse.
1	5	1150	Cp.	CVC	G.E.
7	5	850	Sh.		Cr.Wh.
2	5	960	Sh.	CCM	Cr.Wh.
4	5	1150	Sh.	RC	G.E.
1	5	1100	Sh.	S	Westghse.
1	5	1675	Sh.	CVC	G.E.
1	5	1150	Cp.	RC	G.E.
1	5	1075	Sh.		Northwestern
1	5	1050	Sh.		Northwestern
1	5	1000	Sh.		Northwestern
1	5	1000	Cp.		Western Elec.
1	5	980	Sh.	CM	Cr.Wh.
1	5	935	Sh.	E2AOR	Western Elec.
2	5	950	Cp.	M	Wstgh.
1	5	930	Sh.		Northern Elec.
1	5	900	Sh.	A5	Gibbs.
1	7½	1600	Sh.	CVC	G.E.
6	7½	1425	Sh.		Cr.Wh.
1	7½	900	Sh.		Cr.Wh.
3	7½	875	Sh.	K	Allis Chal.
1	7½	825	Cp.	CVC	G.E.
1	7½	585	Cp.		Northern Elec.
1	10	1260	Sh.		Cr.Wh.
1	10	1175	Sh.		Milwaukee
1	10	900	Sh.	Mp.	Akron
1	10	400/900	Var.	SA	Westghse.
1	10	825	Sh.		Cr.Wh.
1	10	850	Cp.		G.E.
1	10	812	Sh.		Northwestern
1	10	700	Cp.		Westghse.
1	10	2700	Sh.		Northwestern
1	11½	1125	Sh.	S	Westghse.
1	15	1000	Sh.	S	Westghse.
1	15	1400	Sh.		Bullock
1	15	875	Sh.		Imperial
1	15	750	Cp.	K	Allis Chal.
1	15	625	Sh.	G	Eddy
2	15	800	Sh.		Cr.Wh.
1	15	1100	Sh.	B-10	Milwaukee
1	15	825	Sh.		Western Elec.
1	15	812	Sh.		Northwestern
1	15	664	Sh.		Northwestern
1	20	850	Sh.	S	Westinghse.
1	20	800	Sh.	CVC	G.E.
1	20	800	Sh.		Imperial
2	20	625	Sh.	K	Allis Chal.
1	20	674	Sh.		Norhtwestern
1	20	650	Sh.		Milwaukee
1	20	600	Sh.		Western Elec.
1	22½	410	Cp	K	Allis Chal.
1	25	760	Sh.		Northwestern
1	25	650	Sh.	K	Allis Chal.
1	26	1025	Sh.	CCM	Cr.Wh.
1	30	950	Sh.	M	Westghse.
1	30	950	Sh.	CS-20	National
1	30	630	Sh.		Northwestern
1	30	575	Sh.	K	Allis Chal.
1	38	590	Sh.		Gibbs.
1	40	550	Sh.	S	Westghse.
1	40	575	Sh	A-30	Milwaukee
1	40	950	Sh.	M	Westghse.
1	40	675	Sh.		Northwestern
1	40	620	Sh.		Western Elec.
1	50	625	Sh.	A-40	Milwaukee
2	55	550	Cp.	K	Allis Chal.
1	55	575	Sh.	E2AOR	Western Elec.
1	60	500	Cp		Blomkum Elec.
1	65	750	Cp.		Northern
1	65	610	Cp.	Mp.	G.E.
1	75	550	Cp.	K	Allis Chal.
1	75	850	Sh.		Milwaukee
1	85	720	Cp	SK	Westghse.
1	100	600	Cp.		Imperial
1	134	650	Cp.		Eddy
1	300	160	Cp.	M	Westghse.
1	600	320	Cp.	M	Westghse.

DIRECT CURRENT MOTORS—500 VOLTS

No.	H.P.	R.p.m.	Wdg.	Type	Make
1	½	1075			R.& M.
1	5	1000			C. & C.
1	7½	850	Sh.		Bullock
1	8½	850	Series		Bullock
1	10	1500	Sh.		Peerless
1	500	300	Cp.	M	Westghse.

DIRECT CURRENT SERIES MOTORS—250 VOLTS D.C.

No.	H.P.	R.p.m.	Type	Make
2	25	250	12-A	Westghse.

ALTERNATING CURRENT MOTORS—3-PH., 60-CY.

These motors are Westinghouse, General Electric, Allis-Chalmers and other standard makes.

No.	H.P.	R.p.m.	Volts
7	1	1710	220-440
8	1	1140	220-440
6	2	1710	220-440
3	2	1135	220-440
10	3	1720	220-440
12	3	1140	220-440
10	5	1730	220-440
12	5	1140	220-440
8	5	860	220-440
10	5	680	220-440
10	7½	1735	220-440
10	7½	1150	220-440
9	7½	860	220-440
3	7½	680	440
8	10	745	220-440
12	10	1150	220-440
10	10	860	220-440
5	15	1740	220-440
10	15	1150	220-440
6	20	1740	220-440
5	20	1150	220-440
7	20	865	220-440
8	25	1750	220-440
3	25	1150	220-440
4	25	860	220-440
4	30	1750	220
3	30	1150	220
3	30	860	220
2	40	1750	440
3	40	865	220-440
4	50	1700	220-440
3	50	855	220-440
1	50	490	440
1	75	1150	440
1	75	865	220
1	100	1140	440
1	100	720	2200
1	150	720	440
1	250	600	2200 Syn.
1	250	600	440 Syn.

ALTERNATING CURRENT SLIP RING MOTORS—3-PH., 60-CY.

No.	H.P.	R.p.m.	Volts
5	10	1160	220-440
2	10	870	440
1	25	1155	220
1	25	1155	2200
2	30	865	220-440
2	50	870	220
2	75	865	220
2	100	865	220
2	150	720	440

ALTERNATORS

No.	KVA.	R.p.m.	Volts	Make
1	200	600	2300	Westinghouse

DIRECT CURRENT BELTED GENERATORS AND EXCITERS

No.	KW.	Volts	R.p.m.	Wdg	Make
1	11¼	125	1200	Cp.	Westghse
1	12	230	825	Cp.	Allis-ch.
1	15	230	870	Cp.	Imperial
1	18	250	500	Cp.	Allis-Ch.
1	17½	125	1200	Sh.	Triumph.
1	24	250	1150	Sh.	Westghse.
1	20	125	1165		Wagner
1	30	250	675	Sh.	Gibbs
1	28	125	700	Cp.	Westghse.
1	32	250	650	Cp.	Westghse
1	35	125	725	Cp.	Westghse.
2	45	250	650	Cp.	Allis-ch.
1	52	250	700	Cp.	G. E.
1	60	250	950	Cp.	Milwaukee
1	70	250	830	Cp.	Westghse.
1	50	250	850		Northern
1	55	125	850		Westghse.
1	75	250	675		Imperial
1	100	250	750	Cp.	Eddy
1	450	250	300	Cp.	Westghse.
1	500	550	300	Cp.	Westghse. 3-bearing

DIRECT CURRENT ENGINE GENERATOR SETS

No.	Kw.	Volts.	
1	11	125	Westinghouse belted gas engine generator set.
1	21	125	Akron direct connected gas engine generator set.
1	35	125	Westinghouse belted gas engine generator set.
1	50	125	C. & C. direct connected steam engine generator set.
1	55	125	Westinghouse belted steam engine generator set.
1	35	125	Westinghouse belted steam engine generator set.
1	15	220	General Electric belted gas engine generator set.
1	65	250	Westinghouse belted steam engine generator set.
1	75	250	Imperial belted steam engine generator set.

MOTOR GENERATOR SETS

1—100 KW, 250 V., 1200 rpm.,Cp.Wd., with interpoles, new C. & C. generator mounted on common base and direct connected by means of flexible coupling to new 2200 V., 3-phase, 60-cycle Allis-Chalmers motor complete. Available Dec. 15th, 1917.

2—100 KW., 250 V., D. C., 900 rpm., Cp. Wd. Westinghouse generator mounted on common base and direct connected to 2200 V., 3 phase, 60-cycle, self-starting synchronous motor, self-exciting. Available Jan. 15, 1918.

2—150 KW., 250 V., D. C., 1200 rpm., Cp. Wd., with interpoles, new C. & C. generator mounted on common base and direct connected by means of flexible coupling to 1—200 H.P., 2200 V., 3-phase, 60-cycle 1200 rpm., Type AN NEW Allis' Chalmers motor. Available Dec 26, 1917.

DUQUESNE Electric & Mfg. Co.
New and used Electrical Equipment
Pittsburgh, Pa.

R. S. Baldwin Co.

New and Used
Electrical and Steam MACHINERY—Machine Tool
Extensive Export Experience

39 Cortlandt Street, NEW YORK
Registered Cable Address BALDROB NEW YORK

Wire and Cable

40 Miles No. 6 Medium hard drawn copper wire.
10,000 ft. 0000 Weatherproof copper wire.
70,000 ft. 400,000 Circular mils rubber covered cable.
Smaller quantities, other sizes.

The Morse Brothers Machinery and Supply Company
Denver, Colorado

TURBINE—Immediate Delivery

1—500 kw. horizontal Westinghouse Parsons, 2200-2-60. Can be connected for 3 phase. Switchboard panel. Excellent condition.

BOILERS

2—150 H.P., B. & W. Boilers, 200 lbs. pressure.
10—150 H.P., Vertical Manning Boilers, 150 lbs. pressure.
9—100 H.P., Westinghouse slip ring motors, 550 volts, 3 phase, 60 cycles, 720 R.P.M. Complete.

Owned and offered by
Karl Andrén Co., 45 Oliver St., Boston, Mass.

ELECTRIC MOTORS

Alternating and Direct Current

Large Stock—Prompt Deliveries

THE O'BRIEN MACHINERY CO.
119 N. THIRD ST. PHILADELPHIA, PA.

MOTORS-DYNAMOS

Write us what you want to buy or sell

SCHWARTZ & LAND
207 Centre Street New York

DIRECT CONNECTED

GENERATOR SETS

2—Westinghouse 500 K.W. D.C. generators, 500 volts, 910 amperes, complete with switchboards and instruments, direct connected to 2—Cross Compound Pennsylvania Iron Works engines, 18 x 36 x 42.

Can be changed over to 250 volts. Ready for immediate delivery.

HARRY C. SALZBERG & CO., 30 Church St., N. Y. C.

SEARCHLIGHT SECTION

Gas Unit for Sale Cheap

Nash Gas Engine

14 x 16, 3-cylinder, 150 H.P. direct connected to

100 KW C & C Generator

direct current, 220 volts, 260 RPM. complete with air pump, tanks, a... switchboard. Unit practically new Write or wire.

MANUFACTURERS' EQUIPMENT CO.
1201 Wells Bldg., Milwaukee, Wis.

Wire Rope

⅝" to 2". Hoisting, haulage, cableway, tramway and equipment for one mile. Galv. guy rope. Bought. Sold. Bridle and sling chain. Stone dogs (heavy). Steel and wood blocks.

JOHN F. MEIGHAN
865 3rd Avenue New York City

FOR SALE

For Immediate Delivery

1—Epping-Carpenter 16 x 10 x 24 Horizontal Duplex, heavy pressure boiler feed

PUMP

Never been used on account of changed conditions.

The Lorain County Electric Co.
Elyria, O.

IMMEDIATE DELIVERY

of New

Transmission Line Towers

220 Galv. Steel Towers, 40 to 50 ft. high. Designed for two 3-ph. circuits of 4/0 cable, two ⅜" steel ground cables and two No. 6 telephone wires.

P. O. BOX 1223
Pittsburgh, Pa.

FOR SALE

Two 367 H.P.

Heine Boilers

Insured for 125 pounds pressure.

Two 250 H.P.

Geary Boilers

Watertube insured 150 pounds with Rooney Stokers.

20 H.P. Wagner

Motor

A. C. single phase 115-230 volts.

THE HERFURTH ENGINE CO., Inc.
Alexandria, Va.

EQUIPMENT FOR SALE

All in Good Operating Condition

One Fort Wayne **GENERATOR**, Type T. R. B., 60 cycle, 3 phase, 200 K. W., Speed 720, also Exciter Type M. F., 125 volt, 40 amp., Speed 1800.

One Triumph Elec. Co. **GENERATOR**, Type H. R., 60 cycle, 3 phase 180 KVA., also Exciter, 125 V., 60 amp., 7.5 K. W., Speed 1400.

One **SWITCHBOARD PANEL** (Fort Wayne), Black Monson Slate for controlling three (3) 15 K. W., 125 volt exciters and equipped with one TA 125 amp., F-3 Generator voltage regulator complete with rheostat and condenser sections, size 90" x 35" x 1½"—⅜" bevel complete with frame.

Three **SWITCHBOARD PANELS** (Fort Wayne), Black Monson Slate with all necessary instruments for controlling one 450 KVA., 2300 v., 60 cycle, 3 phase Generator; one 200 K. W., 2300 v., 3 phase, 60 cycle generator; one 180 KVA., 2300 v., 60 cycle, 3 phase generator. Size 90" x 24" x 1½"—⅜" bevel complete with frame and remote control, 4500 v., K3 Oil Switches.

Town of Hull Electric Light Department

A. F. Pope, Manager Drawer C. Nantasket Beach, Mass.

FOR SALE

1 General Electric

Motor Generator Set

in excellent condition, new in 1914, consisting of a 6 pole, 50 Kw., 800 r.p.m., 175 volt, compound wound generator, direct connected to a 6 pole, 100 K.V.A., 800 r.p.m., 2200 volt, synchronous motor, complete switchboard equipment.

FS1857, Elec. World, N. Y. C.

Brand New Generating Units for Shorter Delivery

1—75 k.w. 250 volts, 275 r.p.m. Western Electric direct-current generator directly connected to simple, side crank, Single Valve engine. For immediate shipment.

1—75 k.w. 125-250 volts, 250 r.p.m. Western Electric direct-current 3-wire generator directly connected to simple Non-releasing Corliss engine. For four months shipment.

1—300 k.w. 250 volts, 200 r.p.m., direct-current generator, directly connected to simple Non-releasing Corliss engine. For four months shipment.

1—120 k.v.a. 60 cycles, 3 phase, 220 or 480 volts Western Electric alternator, 225 r.p.m., directly connected to a simple Poppet Valve Uniflow engine for steam pressures 125 and up. For immediate shipment.

1—450 k.v.a. 60 cycles, 3 phase, 2300 volts, General Electric alternator, directly connected to simple Non-releasing Corliss engine 150 r.p.m. For nine weeks shipment.

SECOND HAND UNIT

1—40 k.w. 120 volts, 290 r.p.m. Western Electric direct-current generator directly connected to simple, Single Valve, center crank engine. Now in use. For February delivery.

H. A. & G. X. CHUSE, Mattoon, Ill.

Generator Set, Controller, Motor

1—75 kw. Motor Generator Set, consisting of No. 180-L Type S.K. Westinghouse 75 kw., 125 volts, 600 ampere, 860 r.p.m. compound wound, commutating pole generator, direct connected to one 112 hp. Type C.S. Westinghouse 440 volt, 3 phase, 60 cycle, 860 r.p.m. motor. This outfit includes fused auto starter, but no switchboard.

1—New 80 hp., 220 volt, D.C. Cutler Hammer reversing magnetic controller.

1—New 80 hp., No. 80 M.C. Westinghouse, 230 volt, series wound mill motor.

WELLMAN-SEAVER-MORGAN COMPANY
East 70th Street and Central Avenue, Cleveland, Ohio

SEARCHLIGHT SECTION

FOR SALE

2—50 HP. Westinghouse, 2200 volt, A.C., 3 phase, 60 cycle, 1700 RPM.

Motors

direct connected to
2—De Laval, single stage, centrifugal

Pumps

one and a half million gallons, 60 pounds pressure, 147 ft. head.
For further particulars write to

NATHAN KLEIN & CO.
208 Centre St., New York, N. Y.

FOR SALE

1 G. E. Type I-4, Form K, 1100-2200 volt, 3 phase, 60 cycle, 1800 R.P.M.

Motor

with oil compensator and overload and no voltage relay.

HOBART LIGHT & WATER DEPT.,
Hobart, Indiana

FOR SALE

Stranding Machine and Generators

1—6-spool extra heavy special wire Stranding Machine for insulating wire. Flyer 6' 2¾" diam., spools 24" diam.

2—150 K.W., 25 cycle Westinghouse Generators.

THE B. F. GOODRICH CO.
Akron, Ohio

BOILER FEED PUMP

FOR SALE

One 14 x 8½ x 18 outside center packed John A. McGowan duplex feed Pump for 150 pounds boiler pressure.

Indiana Railways & Light Company
Kokomo, Ind.

DIRECT CONNECTED SET

One 400 K.W., 220-440-550-1100 volts, 384 amperes, 3 phase, 60 cycle, 120 R.P.M. General Electric, alternating current generator, direct connected to a Green-wheelock cross compound condensing engine, for 130 lbs. steam pressure, complete with exciter and switchboard. Can be seen running with load.

(N. Y.)—FS1317, Elec. World, N. Y. C.

MARINE SETS—110 VOLTS

3 KW Crocker-Wheeler-Sturtevant
4 KW Diehl-Forbes
6 KW Crocker-Wheeler-Racine
8 KW Northern-Racine
10 KW General Electric
20 KW General Electric

GEORGE BENDER
122 Centre Street, New York, N. Y.

---

70 K.W. Direct Current

Generators

2—70 K.W. Westinghouse, direct current generators, either 250 or 500 volts, 800 R.P.M., brand new, never uncrated, with full switchboard and rheostat equipment.

Southwestern Wrecking Company
El Paso, Texas

FOR SALE

Transmission Line Material

20 miles, 44,000 volt, three phase, including all bo-arrow steel arms, guy wire, bolts, everything complete to smallest detail.

Conductor is steel transmission strand five-sixteenths inch diameter. Detailed lists with prices on application.

Logan County Light & Power Company
Logan, West Va.

FOR SALE

AIR COMPRESSOR

Corliss Type, Size 18 x 32 x 30 x 18 x 36. Manufactured by Laidlaw-Dunn-Gordon Company. Now in operation and in excellent condition.

THE PINE BLUFF COMPANY,
Pine Bluff, Arkansas

Battery Charging Motor Generator Sets

FOR SALE

Ready for Immediate Shipment

Two 1 K.W., 60 cycle, 3 phase, 220 volts, AC. 110 volts, 10 amperes DC.
Two 3 K.W., 220 volts, 3 phase, AC. 110 volts, 30 amperes DC.
One 5 K.W., 3 phase, 220 volts, AC. 125 volts, 40 amperes DC.
These are practically new.

THE ESTERLINE COMPANY
Indianapolis, Ind.

New Copper Wire For Sale

33 miles of No. 2 medium hard drawn 3 conductor stranded bare transmission wire on reels and ready for immediate shipment from Waco.

Advertising Department
TEXAS POWER & LIGHT CO.
Dallas, Texas

Boilers

Three 400 H.P. Keeler, Heine type, watertube boilers, 160 lb. pressure, 6 years old, complete with Murphy stokers.

Two 310 H.P. Babcock & Wilcox boilers, 160 lb. pressure, hand fired.

POWER MACHINERY EXCHANGE
1 Montgomery St., Jersey City

MOTORS

Immediate Shipment

NEW GENERAL ELECTRIC MOTORS IN STOCK

3 Phase, 60 Cycle, 220 Volt, Type KT, Squirrel Cage

Hp.	Speed	Quantity
1	1800	10
1	1200	10
2	1800	15
2	1200	12
2	900	2
3	1800	20
3	1200	12
5	1800	2
5	1200	5
5	900	2
7½	1800	15
7½	1200	12
7½	900	3
10	1800	5
10	1200	3
15	1800	3

3 Phase, 60 Cycle, 220-440 Volt, Form M, Wound Motor

2	1200	1
3	1200	1
5	1200	1
10	1200	1
25	1200	2
35	900	3

3 Phase, 25 Cycle, 220 Volt, Form KT, Squirrel Cage

1	1500	3
1	750	2
2	750	4
3	750	2
5	1500	3
5	750	3
7½	750	2
10	750	3
15	750	3
20	750	6
25	1500	2

The Milwaukee Electric Railway & Light Company
Milwaukee, Wisconsin

FOR SALE

Westinghouse 100 H.P. Suction

Gas Producer

No. 114 complete with hand blower, scrubber, washer, valves, gages and piping. Good condition. Immediate delivery.

LONG ISLAND LIGHTING COMPANY
50 Church Street, New York

SEARCHLIGHT SECTION

Specials for Quick Removal

A.C. UNITS

1—250 KW. with Compound Engine.
2—150 KW. with Automatic Engines.
1—100 KW. with Compound Engine.

D.C. UNITS—250 VOLTS

1—300 KW. with Compound Engine.
1—225 KW. with Compound Engine.
2—100 KW. with Compound Engines.
1— 75 KW. with Simple Engine.
3—800 KW. with Cross Compound Engines.

D.C.—125 VOLTS

2—50 KW. 1—25 KW.
1—40 KW. 1—15 KW.
1—35 KW. 1— 7½ KW.
2—25 KW. Units

BOILERS

1—550 H.P. B. & W. 160 lb. pressure.
2—350 H.P. B. & W. type, 160 lb. pressure.
5—300 H.P. B. & W. type, 160 lb. pressure.
5—300 H.P. Heine type, 150 lb. pressure.
2—260 H.P. B. & W. type, 160 lb. pressure.
5—300 H.P. Stirling, 150 lb. pressure.
3—72" x 18' Return Tubular, 110 lb.
3—80 H.P. Return Tubular, 125 lb. pressure.
Innumerable others, all sizes.

ENGINES

1—10 x 24" Hamilton Corliss Engine.
2—16 x 36" Corliss Engines.
1—16 x 42" Bates Corliss Engine.
1—22 x 48" Brown Corliss Engine.
1—30" x 42" Penna. Iron Works Heavy Duty Engine.

POWER EQUIPMENT COMPANY
Engineers
1218 Chestnut St. Philadelphia

Motor for Sale

1—50 hp., G. E., Form L, 900 r.p.m., 2200 volt, 60 cycle, 3 phase, induction motor. Winding sound, bearings good.

Conway Springs Electric & Ice Co.,
Conway Springs, Kan.

30 HP. 850 RPM., 220 Volts, 3 O, 60 Cycles, New Crocker-Wheeler complete.
25 HP. 220 V., D.C., Westgh., Type S. Large stock of A.C. motors, all for immediate delivery.

BALDWIN & COPELAND,
16 Yale Ave. Jersey City, N. J.

FOR SALE
Three Westinghouse 300 KVA, O.I.W.C.

TRANSFORMERS

25 cycles, 12000/50, 70, 100 volts in good condition, suitable for electric furnace work.
Address Purchasing Agent, P. O. Box 536, Niagara Falls, N. Y.

This advertisement might be your own and get you the attention of other readers of Electrical World. They number over 21,000. Have you anything to sell them?

Motor and Direct Connected

PUMP

1—100 H.P. General Electric, type I, slip ring motor, 3 phase, 60 cycle, 2200 volts, direct connected to a Platt Iron Works centrifugal pump, 1000 gallons per minute, 230 ft. head. Price, f.o.b. St. Paul, Minn.....$1600

PIONEER ELECTRIC CO.
St. Paul, Minn.

A. C. Direct Connected Set

FOR IMMEDIATE DELIVERY

Duplex Compound American Ball Engine

15 and 30x18

Direct connected to 450 KVA, 3 phase, 60 cycle, 2300 volt, 200 speed, Allis-Chalmers Generator. Generator 3 years old.

JOSEPH MYERSON
274 Commercial St., Boston, Mass.

FOR SALE
2—65 H.P. twin cylinders Hornsby-Akroyd complete with 700 gallons fuel tank, air storage tank for starting,

Air Compressor

and piping.
2 S50—35 K.W., 125 volts, 200 R.P.M. compound wound engine type Sprague Electric

Generators

Direct connected to oil engines.
2 panel switchboard 1¼" blue Vermont marble. Each panel contains 1 ammeter, 1—2 pole Cutter circuit breaker. 1—3 pole main switch, rheostat, hand wheel, ground lamps and pilot lights. Also 1 Bracket voltmeter. Price, per unit, $5,000.

EDWARD L. SIMONS, Lansdowne, Pa.

WANTED
Mixed Pressure

"Turbo" Generator Set

of about 500 K.W. capacity, 3 phase, 60 cycle, 2200 volts. Exhaust stages to utilize steam from hoisting engine and mill engine at about 1 lb. pressure. Live stages to utilize steam at 140 lbs. Complete with exciter and condenser if possible.

2 Motor Generators

200 K.W., 250 volt, D.C. and 3 phase, 60 cycle, 2200 volt A.C.

RETSOF MINING COMPANY
Retsof, N. Y.

3 Phase — MOTORS — 60 Cycle

HP.	Make	Volt	Rpm.	Type	Price
115	Allis C.	440	560	SQ	$1250
100	Allis C.	440	570	SQ	1150
100	Wagner	220	850	Slip ring	1150
75	G. E.	440	514	SQ	1150
75	G. E. DC.	220	500	Mill type	650

ROSE ELECTRIC CO.
6401 State St. Chicago, Ill.

25 H. P. MOTOR

25 H.P. General Electric Variable Speed Motor, 110 volts, 250 to 400 R.P.M. with controlling apparatus complete.

C. F. S., Room 1381, 50 Church St., New York City

FOR SALE
One 20 x 20 Chuse side-crank, right-hand

4-Valve Engine

Speed of 200 R.P.M. for 95 lb. steam pressure, non-condensing with Rochester force feed lubricator and indicator with extended base for direct connecting and including one Ft. Wayne **pump** D, 250 K.V.A., 200 R.P.M., 3 phase, 60 cycle, 480 volt **Generator** with 10 KW., 850 R.P.M., belted **exciter** complete with **switchboard** and necessary instruments for same.
This **Generator** is set up and can be demonstrated on request.

THE AZTEC COAL MINING CO.
632 Cooper Building, Denver, Colorado

Crocker-Wheeler Motors

only a few left

HP	R.P.M.	Type	Amperes
1—1½	1200	CM FL	3.95
2—7½	875	CM 75-F	27.5
3—20	775	CM 20D	74
1—25	750	CM 25D	91

Used by us only. Dismantled plant.

McNEELY COMPANY
400 Arch Street, Philadelphia

New Induction Motors for Sale

3 Phase, 60 Cycle, 220 Volts Standard Makes Complete with starters, base, pulley, etc., in Original Crates.

No.	HP.	RPM.	Price Ea.
2	3	1800	$80.00
2	5	1800	95.00
2	10	1800	200.00
1	20	1800	300.00
1	20	1200	350.00
2	30	1200	460.00
1	40	1200	510.00
1	50	1800	515.00
1	50	900	635.00
1	75	720	925.00
1	35	900	400.00

E. S. LINCOLN, INC.,
No. 534 Congress St., Portland, Maine

1—Direct connected unit 100 Kw. Crocker-Wheeler Generator with Payne Automatic Engine.
Absolutely in first-class condition. F.o.b. New York—$2,000.

The Curtiss-Willis Co., 30 Church St., New York City

Keep Your Eyes on the Searchlight Section and your Ad in it

SEARCHLIGHT SECTION

WANTED—FOR IMMEDIATE DELIVERY

TURBO GENERATORS

1—2000 K.W. (or 3000 K.W.) A.C. Turbo-Generator. Turbine for 150 lbs. steam pressure. Generator for 600 volts, 3-phase, 60-cycle current. To include condenser, water and air pumps, and motor generator exciter set.

1—500 K.W., D.C. Turbo-Generator. Turbine for 150 lbs. steam pressure. Generator to be compound wound, for 220 volts. To include condenser, water and air pumps.

PRESSED STEEL CAR COMPANY,
Pittsburgh, Pa.

RENT

40′x140′ first floor and basement, 721-3-5-7 Arch St., in the heart of the machinery district of Philadelphia.

LIEBERMAN & AXILBUND
"Central Leasing A Specialty."
1237 Market St., Philadelphia, Pa.

Generating Units and Transformers

WANTED

We are in the market for a 150 K.V.A., 60 cycle, 2300 volt generator, direct connected to a standard automatic engine; also in the market for transformers for same. Anyone interested, please address the

WASHBURN LIGNITE COAL CO.
Wilton, No. Dak.

WANTED

Armature for Westinghouse Generator

110 K.W., 440 Amp., 650 R.P.M., 250 E.M.F.

Will rewind if necessary.

H. HALLBERG
266 Clermont Ave., Jersey City, N. J.

FOR SALE

300 KVA Set

(First-class—Used)
Immediate delivery

Bullock

60 cycle, 3-phase, 240 volts, direct connected to 21″ x 27″ Erie City 4-valve Engine, 150 R.P.M.

Very cheap.

RAILWAY & MINE SUPPLY CO.
332 S. Michigan Ave. Chicago, Ill.
Tel. Harrison 7382

Battery Material

Wanted at Once

any quantity of battery lead plates, sediment, scrap copper, brass and all other grades of metals. Complete battery stations dismantled anywhere.

Describe in Detail
Get Our Prices

National Metal & Rubber Co.
39 India Wharf, Boston, Mass.

WANTED Traveling Crane

capacity 5 to 10 tons, bridge span 50 to 70 ft., height of lift 15 to 20 ft., total travel about 200 ft. Motors wound for 220 volt, 60 cycle, 3 phase. Early delivery required.

NATIONAL ELECTRICAL SUPPLY CO.
1328 New York Ave. Washington, D. C.

Immediate Delivery—A Rare Bargain

Engine and Generator

One 17″ x 24″ Fitchburgh Corliss non-condensing engine with 10 ft. fly wheel direct connected to Bullock 150 K.W. direct current Generator, 1250 amperes, 116-120 volt, 150 R.P.M.

This outfit is in excellent condition and is complete with all parts for service. Volt meter, Ammeter, Rheostat, Circuit breaker, Cable, etc. Can be inspected set up and working. It has been maintained in fine shape and is as good as new.

Price is very reasonable, as it is to be replaced by large machine and must be moved quickly.

If interested wire for price.

Hoisting Machinery Co., 50 Church St., New York, N. Y.

FOR SALE

Engine for Sale

10 x 20 side crank, automatic, balanced valve, engine, in good operating condition. The Seely Electric Co., Inc., Spencer, N. Y.

Transformers for Sale

Two 15 KVA, 550 volt primary, 110/220 volts secondary, 60 cycle, single phase, oil cooled Pittsburgh Transformers. N. E. Machine & Electric Co., Pawtucket, R. I.

Mica Mine for Sale

Located in Southern Virginia, three miles from railroad, developed and sold over eight thousand dollars' worth of large clear mica. Call or write. State Lime Mica Co., Ridgeway, Va.

Wanted and for Sale

Wanted to buy for cash alternating and direct current motors. Send list of what you have for sale. For sale cheap 30 kw., 125-volt DC. Generator. A. Werby & Co., 47 Beverly St., Boston.

D.C. Generator for Sale

1—275 K. W.—250 Volt—150 RPM—G. E. engine type, direct current generator. Immediate delivery, perfect condition. Philadelphia shipment. Address J. D. Cudney, 501 5th Ave., New York City.

FOR SALE

Boiler, Heater, Etc., For Sale

One 260 HP. Heine Watertube boiler. 160 lbs. steam pressure, in good condition. Also 1000 HP. Cookson heater, filter, oil separator, and 300 dryer cars. J. P. Vinson, 45 South Lexington Ave., St. Paul, Minn.

Motor Generator Set

Generator, 100 Kva., Burke, single phase, 60 cycle, 125 volt, can rewind to 3 phase any voltage. Motor 150 hp. Burke D.C. 600 volt, 900 r.p.m., $1,850. Rose Electric Co., 6401 State St., Chicago, Ill.

D.C. Generators for Sale

90 kw., 750 r.p.m., 125 volt, Gen. Elec.
55 kw., 850 r.p.m., 125 volt, Westingh'se.
40 kw., 700 r.p.m., 240 volt, Peerless.
All in excellent condition, complete and fully guaranteed.
V. M. Nussbaum & Co., Ft. Wayne, Ind.

Motor Generator for Sale

75 kw. Motor Generator Set, $850. Generator 75 KW., 125 volt, 1200 R.P.M., direct current compound wound, complete with flexible coupling cast iron base and modern switchboard panel. All in unusually fine condition. Without Motor. Rose Electric Co., 6401 State St Chicago, Ills.

FOR SALE

110 Volt Marine Sets

1.65, 3, 5, 10, 15, 20 K.W., all vertical type, steam engines. James K. Hooper, 50 Church Street, New York City.

Telephones and Wire for Sale

Immediate shipment 50,000 feet No. 19 three-conductor new telephone wire at $15 per thousand in 5000 ft. lots; 2500 ft. 12 pair used braided telephone cable at 5c. per ft.; 12 twenty-station used desk and wall type couch telephone at $4 each. A. J. Doterweich Co., Inc., 285 Washington St., Buffalo, N. Y.

MISCELLANEOUS WANTS

Cable Wanted

Lead covered cable wanted for submarine use at 4400 (or 440) volts. Two conductors, No. 8 or larger. Central Connecticut Power & Light Co., East Hampton, Conn.

WANTED—One 50 H. P. Gas Engine and Gas Producer

Suitable for same. Must regulate well enough to run A.C. generator and be in first-class condition

VANCEBURG LIGHT CO.
Vanceburg, Ky.

SEARCHLIGHT SECTION

BUSINESS OPPORTUNITIES

Business for Sale

Going Electric Manufacturing business in Chicago. Electric Light Plants, Storage Batteries and Specialties. Illinois corporation. Contracts in hand for several months. Splendid location and factory. Will sell for inventoried assets $24,500. Full investigation invited. Address Manufacturer, 4111 Ravenswood Ave., Chicago, Ill.

Business for Sale

Electrical Supplies and Contracting Business with complete equipment for repairs to motors and generators; one of the best known repair shops in the state; considerable income from repairs to electrical apparatus on automobiles; business acquired by delivering good work therefor with present policy continued customers will remain customers. We contemplate investing in larger enterprise; will sell outright or interest in business; prospective buyer must invest at least $5000. One of the best small investments ever offered anybody with a fair knowledge of electrical matters. Address B. O., 2319, Elec. World, Chicago.

An Exceptional Opportunity

In order to close an estate, a manufacturing business long established in New York City, is for sale.

Average profit for last 10 years has been *above* $30,000 a year.

Will require approximately $150,000, half of which is for the real estate.

This is worth a prompt investigation.

Box 2246, Elec. World

POSITIONS WANTED

A MAN of 22 years' experience in the electrical industry, desires a connection as sales manager of a manufacturing concern or commercial manager of a lighting and power corporation. Eight years' experience in heating and cooking appliances and small power devices. Not subject to draft. Open after January 15. PW2468, Elec. World.

CONTROLLER, manager. — Seventeen years' successful record. Gas, electric and water plants. References—prominent engineers, etc. PW2412, Elec. World.

ELECTRICAL engineer, technical education, ten years' experience in station and sub-station design and construction and large power installations, desires responsible position in design or field work. PW2470, Elec. World, Chicago.

ELECTRICAL engineer, technical graduate, 6 years' experience as power sales engineer, desires position as new business manager of a progressive central station. At present employed. PW2410, Elec. World, Philadelphia.

ELECTRICAL engineer, technical graduate, 34, married, 15 years' experience designing and constructing power plants on land and merchant steamers, desires permanent and responsible position. PW2402, Elec. World.

ELECTRICAL graduate, six years connected with Eastern sales office, handling all kinds of machinery, wishes position with purchasing department. Especially fitted for traveling inspector. Married. Over draft age. Available January. Moderate salary. Answer quick. PW2469, Elec. World, Philadelphia.

In Replying to "Blind" Ads

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36th St. and 10th Ave., New York.
1570 Old Colony Bldg., Chicago.
657 Leader-News Bldg., Cleveland.
935 Real Estate Trust Bldg., Phila.
501 Rialto Bldg., San Francisco.

Important

Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents—send copies.

Save Time

Have the replies to your ad come direct to you

All our offices forward promptly the replies addressed to box numbers—yet this indirect method of receiving letters or telegrams necessarily causes some delay and in these abnormal times even a slight delay may prove serious.

To sign your name and address to your advertisement begets confidence in the reader. You can, however, obviate delay in forwarding replies by signing your ad only with initials (your own or others), care of your home, your office or a post-office box number in your city.

For quick and satisfactory results tell the reader everything that he will want to know.

POSITIONS WANTED

ELECTRICAL engineer, technical graduate, 8 years' experience, 2 years engineering apprentice, 1 year correspondence, 5 years electric power salesman, would like position with central station superintendent, new-business agent, or as motor salesman. PW1291, Elec. World, Philadelphia.

ELECTRICAL engineer, graduate 1912, 33 years of age, married. Several years with General Electric Company. Experienced in power plant work and oil engines. At present electric and water superintendent municipal plant. Desire similar position with private concern. PW2418, Elec. World.

ELECTRICAL, mechanical engineer, technical graduate, age 35 years, 15 years' experience G. E. test, construction and operation of power plants, substations, distributing systems and efficiency work, at present employed as electrical and mechanical engineer for a large mining company. Desires position in the East. References. Present salary $3000. PW 2476 Elec. World, Chicago.

ELECTRICIAN and thorough all-around mechanic. Fourteen years' experience construction, maintenance. PW2477 Elec. World.

EXECUTIVE or commercial connection with a central station that requires the services of a modern business builder and engineer. Ten years' central station experience. Seven years as a commercial power engineer for a company serving 42,000 customers. Technical graduate. Age 36; married. PW2105, Elec. World, Chicago.

POSITIONS WANTED

MAINTENANCE engineer, age 33, 16 years' steam, electrical construction, and maintenance mining and industrial plants; boilers, piping layouts, engines, turbines and auxiliaries; high and low tension switchboards, wiring, lighting and power, electrical repairs, power calculations; salary, $200 per month. Address Box 438, Somerset, Ky.

MANAGER—A thoroughly competent superintendent or manager of electric light or power properties. Now employed as such by large corporation. Eighteen years' successful experience with same interests. College graduate. Long experience in commercial end of the business, conducting campaigns, etc., both light and power. Thoroughly familiar with long distance transmission, substations and local line construction. Eminently successful in control of labor and knows how to get business in Southern territory where there is opposition to corporate management or ownership. Desires change where would have more direct connection with controlling interests. Would only consider position in the South. Correspondence solicited. PW 2474, Elec. World, Philadelphia.

POSITION wanted by electrical and mechanical engineer, technical graduate, experienced draftsman on generating stations and high and low tension substation layouts, familiar with transmission line work and also industrial electrical engineering. PW2411, Elec. World.

PURCHASING agent, thirty-three years; married; fifteen years' experience in electrical field. Now purchasing for large central station, construction and traction companies. Change desired. References. PW2472, Elec. World, San Francisco.

PRACTICAL electrician desires position as superintendent, chief electrician, or assistant. Sixteen years' experience in installing, maintaining, operating and superintending electric light and power plants. Married, sober, not afraid of work. PW2255, Elec. World, Cleveland.

PRACTICAL electrician, technically trained, five years' experience, three years General Electric testing laboratories, two years distribution and maintenance, age 23, desires position with power or industrial plant, A No. 1 references, north central states preferred. PW 2479 Elec. World, Chicago.

RESEARCH Engineer desires position dealing with experimental or mathematical investigation of electrical apparatus. American, 37 single, technical graduate, 8 years' valuable experience. East preferred. PW2325 Elec. World.

SUPERINTENDENT desires position managing electric property in a town of 15,000 to 20,000. Available in January. Age 35, married. References furnished. Salary $2,000. PW2463, Elec. World, Chicago.

SUPERINTENDENT of power or works engineer. Position desired by mechanical and electrical engineer, over 20 years' experience, competent to design, construct or oversee operation of steam generating plants and electrical power distribution for large factory, shipyard, public utility or engineering company. PW2414, Elec. World.

Manufacturers

A highly responsible business man, with a lifelong experience in selling electrical specialties, desires to secure the sole representation for Chicago or the entire middle West for a product of merit. Will carry Chicago stock and guarantee results—highest credentials.

S 2465 Electrical World, Chicago

SEARCHLIGHT SECTION

POSITIONS WANTED

YOU want a superintendent for your light plant; I want the job. I have technical training and practical experience in power station operation, experience in sales work and handling the public. Now Chief Engineer large power plant. Will consider any good proposition in a town of 1500 to 5000 inhabitants. Salary $1,500 to $1,800. PW2464, Elec. World, Chicago.

POSITIONS VACANT

ASSISTANT to Works Manager wanted. Must have technical training in Mechanical and Chemical Engineering and at least ten years' experience, including actual charge of quantity production; $3,000 to start. Give full history and references in first letter. P2462, Elec. World, Chicago.

AT ONCE—Electrical engineer for the mechanical design of transformers. Some knowledge of strength of materials necessary. Splendid opportunity for advancement. State salary wanted and give complete data in first letter. P 2261, Elec. World, Cleveland, O.

CHIEF Engineer wanted to take charge of combination lighting and ice making plant in Texas town of 15000. Must be capable man with experience in handling engines, turbines, gas engine, boilers and ice machinery. Answers to be accompanied by record, giving experience and salary expected. P. O. Box 398, Marshall, Texas.

WANTED

EXPERIENCED ELECTRICIAN

to take charge of motor repair shop. Must have thoro knowledge of all makes of motors and generators, both A.C. and D.C. Must come well recommended. State experience, references and salary expected in first letter.

THE FUERST-FRIEDMAN CO.
CLEVELAND, OHIO

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501 Rialto Bldg., San Francisco.

Important

Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents—send copies.

POSITIONS VACANT

DESIGNING draftsmen wanted for permanent positions. Men with electrical, steam engine, turbine or special machine experience. Applicants give age, education, former experience and salary expected. Address Chief Draftsman, General Electric Co., Lynn, Mass.

DISTRIBUTION engineer who has had experience in overhead line construction and maintenance wanted; technical graduate preferred; salary $90 per month at start. Location Middle West. P2400, Elec. World, Chicago.

DRAFTSMAN, experienced on making wiring diagrams. One familiar with hydro-electric station construction and operation. Pennsylvania Water & Power Company, Holtwood, Penn.

DRAUGHTSMEN — Electrical; familiar with power plants and substation work. Applicants should state full personal and technical qualifications, including education, experience, character of past and present positions, and salary desired. Address Mr E. B. Severs, 315 Arch St., Philadelphia, Pa.

DRAFTSMAN required for special work related to electro-chemical and metallurgical lines. Previous experience on these special lines not absolutely necessary but smart, intelligent man with good mechanical or electrical drafting experience would meet requirements. Splendid opportunity for right man. Apply, giving full particulars, age, salary expected, etc., to P2401, Elec. World.

POSITIONS VACANT

ELECTRICAL engineering graduate wanted, who has had year or two practical experience in sales work. P1410, Elec. World, Cleveland.

ELECTRICAL draftsman for power house and sub-station layout. State age, education, experience and salary desirde. P2481, Elec. World, Chicago.

ELECTRICIAN, by manufacturing plant, one who can keep electrical machinery running. Whole plant electrically driven, alternating current. Salary $100 monthly; fine living conditions, location East. P2268, Elec. World.

EXPERIENCED electrician wanted for maintenance work in sawmill plant. Must be competent to keep up electric plant, motors, switchboards and a good armature winder. Good opportunity for the right man. Address Burton-Swartz Cypress Co. of Florida, Perry, Fla.

LARGE manufacturer of Automobile Electrical Equipment has a managerial position for a competent man. Should have technical education and practical electrical experience. A good correspondent with office training preferred. State age, education and salary expected. P2473, Elec. World.

MAN to take position as Sales Engineer handling Motors, Lamps, Wiring, etc., with Electric Contractor in large New England city wanted. Salary and commission. Preferably man with General Electric test experience, exempt from draft. P2461, Elec. World.

MANUFACTURER of electrical machinery needs test floor men. All grades, including men with practical experience only; as well as technical graduates. Good wages and excellent opportunities for advancement. P1246, Elec. World, Philadelphia.

MARRIED man over thirty, experienced in house wiring, meter setting and reading, and city distribution and maintenance, wanted; capable of taking charge of a distribution system in a small town. Applicant must be sober and thoroughly capable of dealing with the public in handling a position of this kind. References must also be furnished with application. Virginia-Western Power Co., Clifton Forge, Va.

Designers Wanted

First class die and tool designers, experienced on modern punch press dies for blanking and forming complicated parts in sheet metal machining and tools for machining small drop forgings, aluminum and bronze castings similar to automobile, gun and sewing machine parts.

First class men, capable of designing practical and accurate working tools will receive best of wages in accordance with their ability and diligence.

The opportunity is open now for men in this line who are American citizens to employ their skill in the service of their country. Call or address at once

CURTISS AEROPLANE & MOTOR CORP., Attention C. E. Fouhy, 2000 ELMWOOD AVENUE, BUFFALO, N. Y.

ELECTRICAL DESIGNERS AND DRAFTSMEN

The American International Shipbuilding Corporation, as agent for the Emergency Fleet Corporation, is constructing a large number of cargo ships and transports for government use and requires the services of five expert Electrical Designers and five Electrical Draftsmen on Industrial and Power Plant Work. This is an exceptionally attractive proposition for high-class men. Make your application by letter only. State fully your education, record and present salary.

ADDRESS: DRAFTING DIVISION

AMERICAN INTERNATIONAL SHIPBUILDING CORPORATION

140 North Broad St., Phila., Pa.

SEARCHLIGHT SECTION

POSITIONS VACANT

METER man wanted experienced, for testing single and poly-phase meters. In replying state salary expected and experience. P2323, Elec. World, Chicago.

OLD established Chicago concern wants a man with the following qualifications. Must be able and willing to do fair work on lathe drill press or at the bench, understand small A.C. and D.C. motors and generators thoroughly, travel part of the time installing machines and assist head of the department; $125 monthly. Give experience and references in full detail. P2466, Elec. World, Chicago.

POWER superintendent. A large railway and power company located in New England requires the services of a thoroughly experienced power superintendent to take charge of a new 20,000 k.w. steam turbine station and about ten sub-stations. Applicants must have a thorough and up-to-date technical and practical knowledge of this class of work and be able to show satisfactory results in present and past work. Apply, stating age, nationality, experience, references and salary expected, to P2406, Elec. World.

SUPERINTENDENT wanted for water works and electric lights in town of 7,000. Write, stating age, experience, salary, etc. Board of Public Works, Coldwater, Mich.

SUPERINTENDENT wanted; Cuban Public Utility concern will pay $3,000 to $3,600 a year according to experience, to a man of executive ability and operating experience of steam and combustion engine light plant, also ice making. P2399, Elec. World.

SUPERINTENDENT wanted for transformer factory; must be practical and experienced in building and assembling power transformers. Apply, stating experience, references and salary required to Canadian General Electric Co., Peterborough, Canada.

Wanted

several good men for office positions; must be familiar with outside plant; telephone and telegraph construction and material; good opportunity for persons with proper qualifications. State past experience and education and salary desired.

Western Electric Co., Inc.
463 West Street, New York City

WANTED

Assistant Electrical Engineer

for 85,000 horsepower hydro-electric plant and large mill, electrical apparatus, in New York State. Young man preferred; long experience not necessary. P 2460, Electrical World.

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Have the replies to your ad come direct to you

All our offices forward promptly the replies addressed to box numbers—yet this indirect method of receiving letters or telegrams necessarily causes some delay and in these abnormal times even a slight delay may prove serious.

To sign your name and address to your advertisement begets confidence in the reader. You can, however, obviate delay in forwarding replies by signing your ad only with initials (your own or others), care of your home, your office or a post-office box number in your city.

For quick and satisfactory results tell the reader everything that he will want to know.

POSITIONS VACANT

SUPERINTENDENT wanted for Hydro-Electric plant in the State of South Carolina. Technical man preferred and Southern man preferred. P2471, Elec. world.

TELEPHONE engineering openings. We have positions offering excellent opportunities to enter the telephone engineering field. Training in electrical engineering or practical telephone experience is necessary. Salary $21 to $28 per week at the start with rapid advancement for those who qualify. In replying state age and particulars of experience. P2331, Elec. World.

WANTED—Experienced designer on Electric Baggage Truck Work. P2467, Elec. World.

AGENTS AND SALESMEN

Solicitor or Engineer Available

Electrical engineer with 7½ years' experience office, test and operating, now in charge light plant, available Jan. 10th for position with small or medium size plant. Technical graduate. Married. Age 28. Box 2343, Elec. World, Philadelphia.

Sales Executive

At present connected with one of the most aggressive of electrical merchandising organizations.

Personally acquainted with territory and electrical industry in United States and Canada.

Eight years' experience.

Desires connection with manufacturer offering unusual opportunities. PW2480, Elec. World.

AGENTS AND SALESMEN

Electrical Supply Salesman Available

Electrician, age 32, married, 8 years' experience in electrical work wants position by January 1st as electrical supply salesman. Good education, best of references. Can deliver the goods. PW2417 Elec. World, Cleveland.

Do You Want Agent in Canada?

I am in position to represent you directly to the trade in Canada. Correspondence is the first essential between you and me. Irving Smith, 809 Unity Bldg., Montreal, Canada.

Do You Want Boston Agent?

Manufacturers: Do You Want Representation in the Boston District, by a live, aggressive man, backed by eleven years of active engineering experience with Public Utilities and Industrial Plants. S 2476, Elec. World.

Salesmen Wanted

Agency for the sale of Neuco Electric Ranges is offered to high-grade men of experience, who have an acquaintance among central stations and jobbers. Address, giving full particulars, National Electric Utilities Corporation, 103 Park Ave., New York City.

Sales Engineer Desires Agency

Sales engineer with 15 years' experience in successfully developing large volume of business in various new lines of apparatus for a large manufacturing company desires to make agency arrangements with manufacturers of electrical and mechanical machinery. S2405, Elec. World.

Let Me Plan Your Campaign

Big sales developing campaigns are my specialty; 15 years' successful experience selling to central stations all over the country makes me of exceptional value to manufacturers desiring to introduce something new or develop an old line. May I help you? PW2267, Elec. World.

EDUCATIONAL

BLISS ELECTRICAL SCHOOL, WASHINGTON, D. C.—Condensed course in electrical engineering, complete in one year. Thorough, practical, scientific. Theoretical and applied electricity, mathematics, mechanical drawing and superficial or non-essential studies. Actual construction of apparatus, installation and testing. For young men of energy and character. 25th year opened Sept. 26. Write for catalog. Address 129 Takoma Ave.

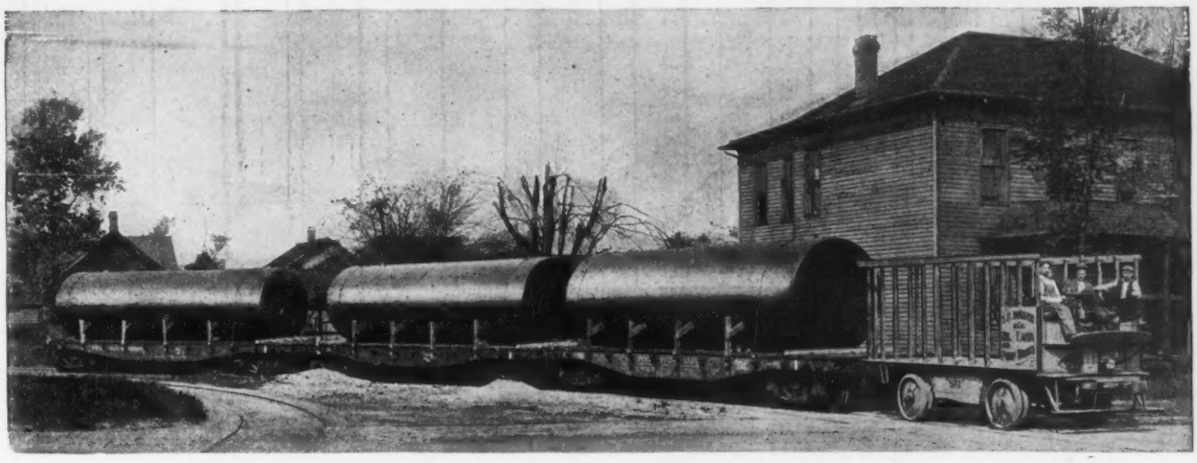
ELECTRICAL ENGINEERING—PRACTICAL ONE-YEAR COURSE. Thorough training in mathematics, mechanics, applied electricity and drafting, including actual installation, operation, testing and repair of electrical machinery and testing of steam and gas engines. Also one year course in mechanical engineering. New building and equipment. Send for catalog. Detroit Technical Institute, Detroit, Mich.

EMPLOYMENT AGENCIES

GENERAL ENGINEERING AGENCY, Pittsburgh, Pa., require experienced power engineers, dispatchers, superintendents, tour electricians, chief electricians in large industries, combustion engineers, draftsmen for over 200 excellent openings, some with cottage. Write for list.

Correspondence Service

The undersigned provides a confidential service designed to locate openings through correspondence for men earning not less than $2,500 and up to $25,000; all lines. Not an employment agency, but a constructive initiative service, covering individual negotiations. Established 1910. Complete privacy assured; present connections in no way jeopardized. Send name and address only for explanatory details. R. W. Bixby, M1 Niagara Square, Buffalo, N. Y.



An electric truck, equipped with Edison batteries, hauling three tank cars

For Heavy, for Medium, for Light Electric Vehicle Service *Use Edison Storage Batteries*

The electric vehicle has a much wider range of service than most people appreciate. From the light 750-lb. delivery wagon to the 15,000-lb. truck, there is a choice for every industry. And for every vehicle there is an Edison battery that is standard equipment, that insures day in and day out satisfaction.

The simplicity of the electric, whether small delivery or giant truck; its ease of operation and control, and freedom from mechanical troubles; together with the mechanical and electrical perfection of the Edison Battery, insure that money-making result—most days in service per year.

Let us tell you more about applying electrics to your transportation situation. Ask for bulletin 500W.

EDISON STORAGE BATTERY COMPANY

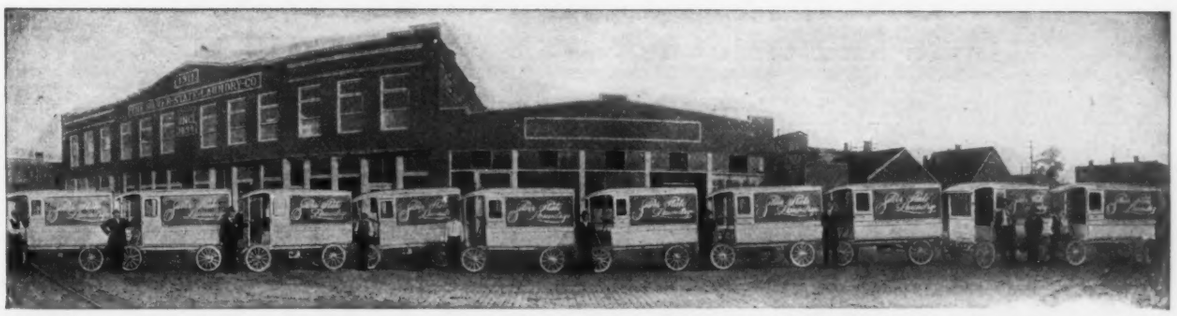
Factory and Main Office: ORANGE, N. J.

EDISON STORAGE BATTERIES

Distribution in

New York Boston Chicago Detroit San Francisco
Seattle Los Angeles New Orleans Pittsburgh

TRADE MARK Thomas A. Edison A PRODUCT OF THE EDISON LABORATORIES



The light delivery system shown here operates in Denver, Colo. Similar fleets are operating in hilly Kansas City, Mo., Pittsburgh, San Francisco, etc., and are giving economical and reliable service. Edison Batteries are standard for this work

THIS shipment of ECONOMY renewable FUSES and Economy "Drop Out" Renewal Links is starting on its way to a U. S. Navy Yard. As compared with the number of "One Time" fuses necessary to provide the same electrical protection, the 324,800 "Drop Out" Renewal Links on the truck alone saved our government

$76,486.90

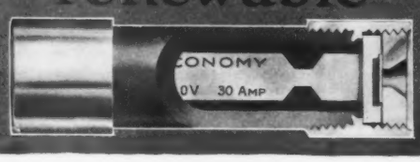
This one order of a total of fourteen, for delivery to several U. S. Navy Yards, establishes a record for efficiency of service. In six working days after the orders were received in the mail, the fourteen orders, comprising scores of thousands of fuses and hundreds of thousands of renewal links, came through production, passed government inspection and were ready for shipment without interfering with our regular delivery to our other customers.

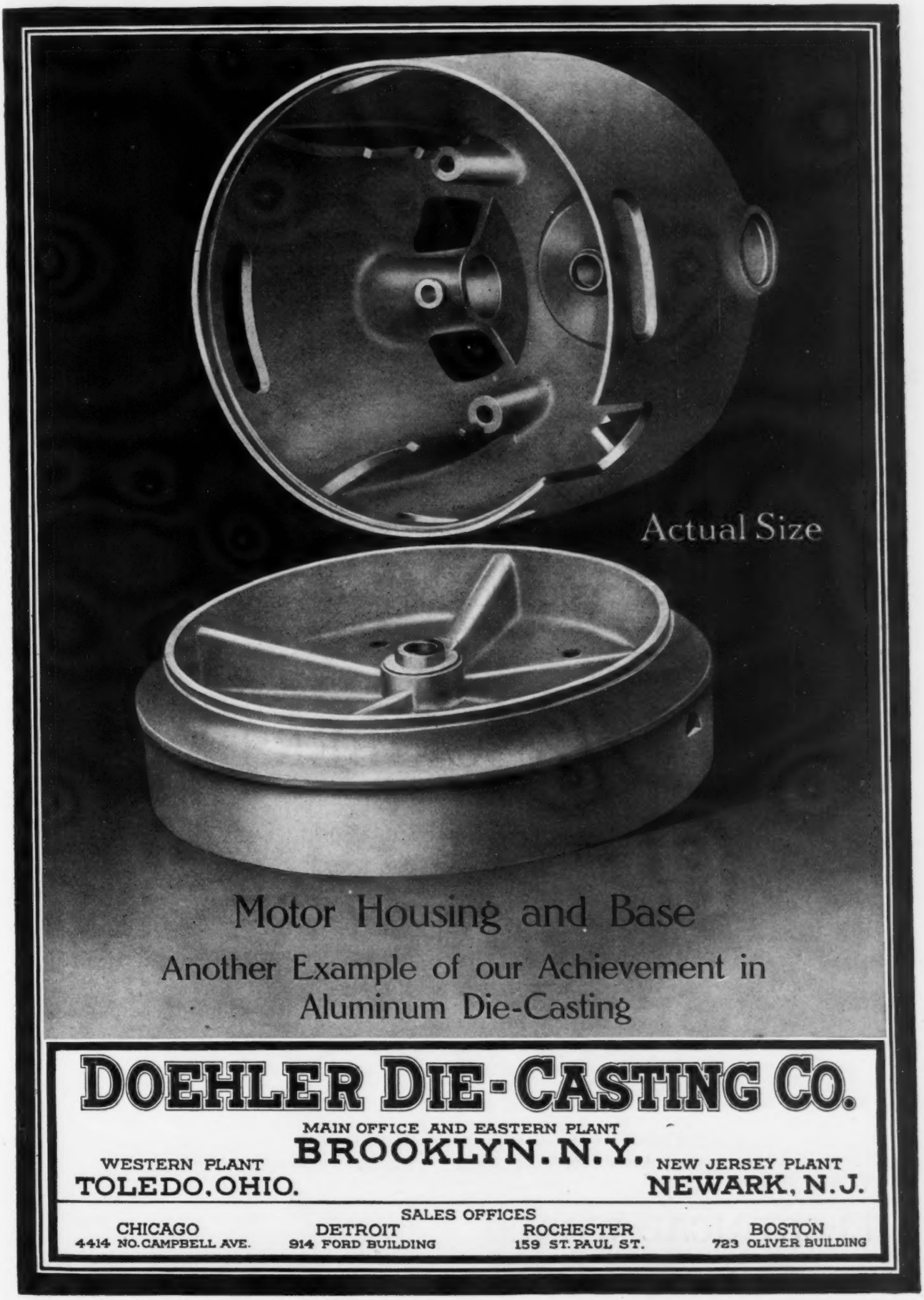
Economy renewable Fuses are sold by leading electrical jobbers and dealers, who will gladly show you the complete line and quote prices.

ECONOMY FUSE & MFG. CO.

Kinzie and Orleans Sts. CHICAGO

Sole Manufacturers of "Arkless" Fuses—"The Fuse with the 100% Guaranteed Indicator"

ECONOMY renewable  FUSES



Motor Housing and Base

Another Example of our Achievement in Aluminum Die-Casting

DOEHLER DIE-CASTING CO.

MAIN OFFICE AND EASTERN PLANT
BROOKLYN. N.Y.

WESTERN PLANT
TOLEDO. OHIO.

NEW JERSEY PLANT
NEWARK, N.J.

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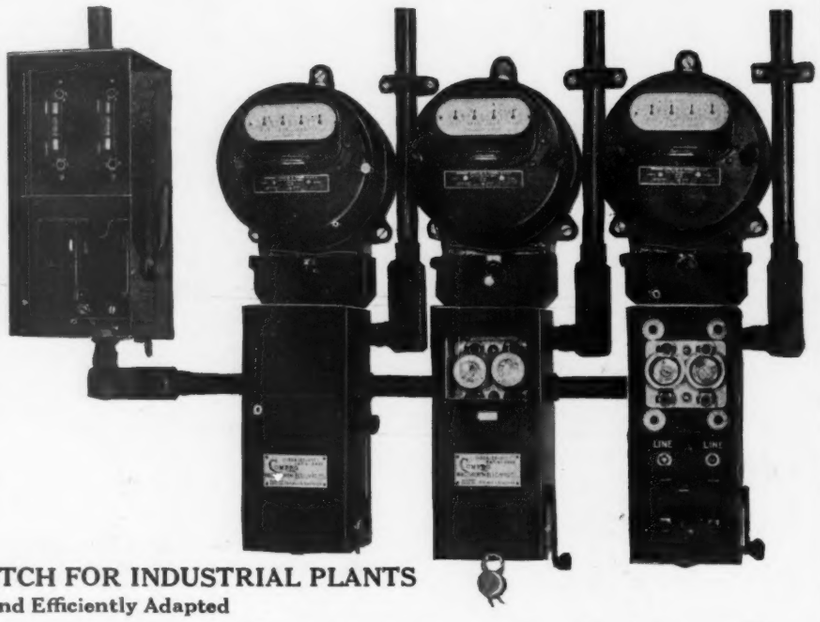
What COMPRO (Commercial Protection) Enclosed Switches do for Central Stations

The Only Enclosed Switch in the World, with Exposed Fuses, where Current-carrying Parts are INACCESSIBLE under ALL CONDITIONS.

Substituting a Plain End at Point Equipped with Meter Adaptor, converts "COMPRO" into a STANDARD COMMERCIAL SWITCH.

1. Their revenue is increased.
2. All lost current is accounted for.
3. Time is saved, as there is no opening of seals for fuse changing.
4. No expense of removing meter when service is discontinued.
5. "COMPRO" Adaptors fit any standard meter.
6. Time saved, as installation is simple. Quickly assembled.
7. Impossible to tap on.
8. When once sealed no need ever to open.
9. Convenient device for meter testing.
10. The unnecessary expense of removing meter or cutting lines is saved by sealing "COMPRO" switch handle in off position with lug when service is discontinued.



"COMPRO" ENCLOSED SWITCH FOR INDUSTRIAL PLANTS
Efficiently Made and Efficiently Adapted

WADSWORTH ELECTRIC MFG. CO., 405 Madison Ave., Covington, Ky.

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If YOUR copy of Electrical World
does not reach you promptly, do not assume that it has been lost or that it was not mailed.

Delays are inevitable just now
in the unprecedented congestion of the mails due to the plight into which war-time conditions have plunged the railroads.

Please wait a day or so
before you write to us—by that time your copy will probably be in your hands. Save that three cents! But if the delay continues write us.

The war is no respecter of persons—
even Uncle Sam is not exempt from its inconveniences.

ELECTRICAL WORLD

Victor

One of ten new and improved Victor designs for different voltages. This one—number 5090—meets the particular insulation requiremnets of 60,000 volt lines.

The supplement to "The Insulator Book" describes and illustrates the latest and most improved Victors. Get a copy—it will help you solve your insulator problems.

Number 5090 for 60,000 Volts

The Locke Insulator Mfg. Co.

Rochester, N. Y.

New York Office
30 Church St.

6

This great Nation is now on a war basis. Back of all its countless industries is war necessity, bringing new and imperative demands and responsibilities to the Bell System, all of which have been satisfactorily met.

American Telephone and Telegraph Company and Associated Companies

One Policy **One System** **Universal Service**

MOLONEY
TRANSFORMERS

Typical installation of 3—1000 KVA, 60 cycle, single phase 33,000 to 2300 volt MOLONEY Type C transformers.

MOLONEY transformers are manufactured from designs that are the result of twenty years of conscientious development.

MOLONEY ELECTRIC CO.
Factories: St. Louis, U. S. A., and Windsor, Can.

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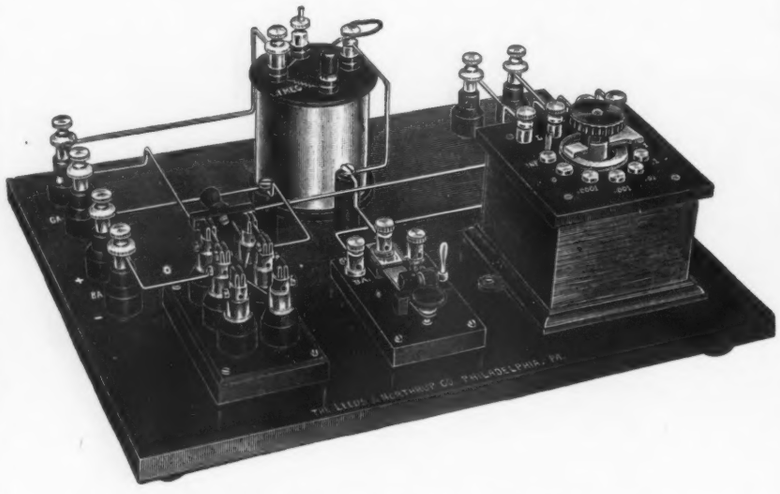
4

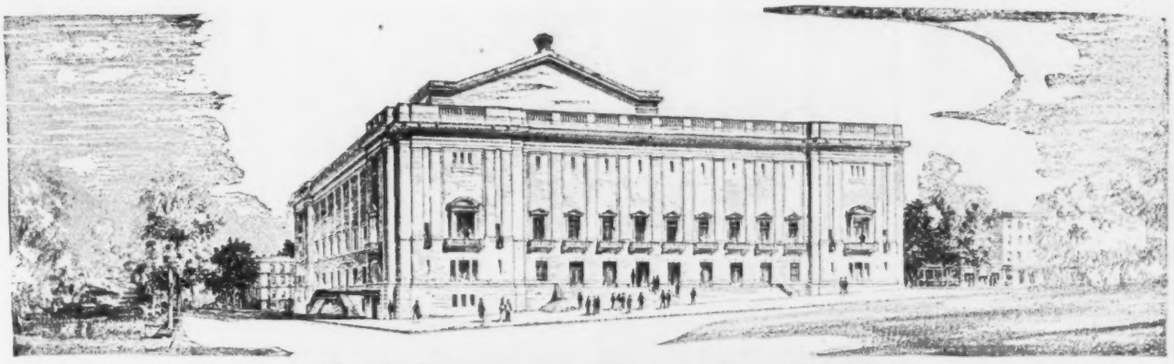
THE MEASUREMENT OF INSULATION RESISTANCE



Insulation Resistances are ordinarily measured by a direct deflection method using a high sensitivity galvanometer and certain necessary auxiliary apparatus. It is exceedingly important that all parts be well insulated one from the other and from the ground. In our factory insulation set, here illustrated, all auxiliary apparatus is mounted upon a hard rubber plate and all connections are run in the air. The galvanometer is mounted separately, its construction being such that it is well insulated from ground.

This set, together with other apparatus for insulation measurements, is described in our catalogue No. 50, a copy of which will be sent upon request.

THE LEEDS & NORTHRUP CO.
ELECTRICAL MEASURING INSTRUMENTS
4903 STENTON AVENUE, PHILADELPHIA



SHERARDUCT was used exclusively in the magnificent Public Auditorium, Portland, Oregon. This building was opened for the Rose Festival, June, 1917.

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Sherardized Rigid Steel Conduit

National Metal Molding Co.
Manufacturers of
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1105 Fulton Building, PITTSBURGH, PA.

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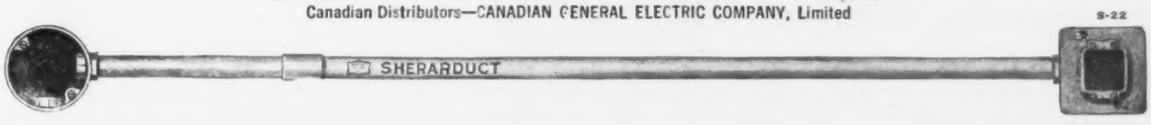
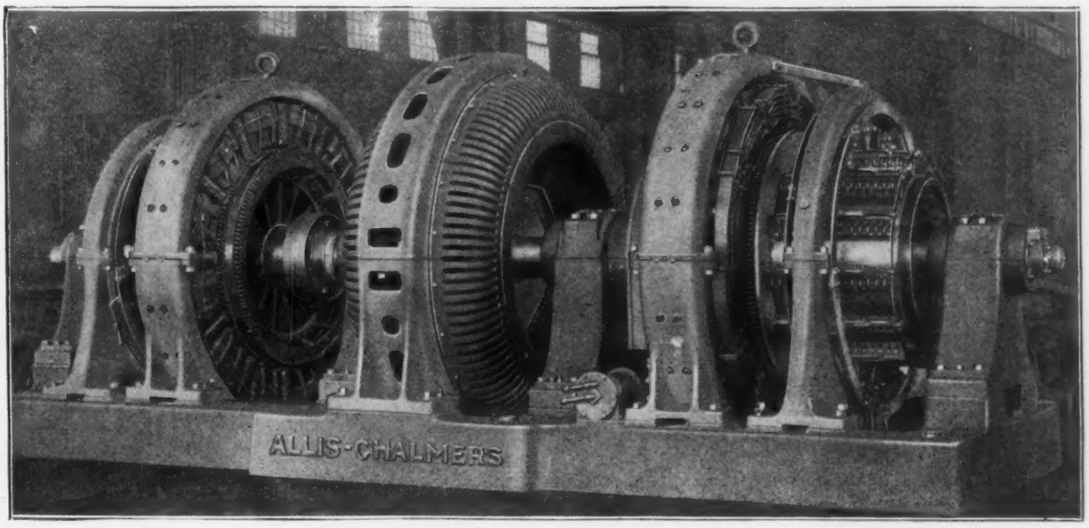
S-22





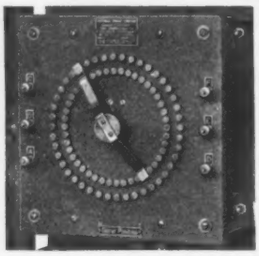
Motor-generator set for electrolytic work. Two 400 kw. generators driven by Synchronous Motor. Generators have voltage range from 65 to 170 volts.

MOTOR-GENERATOR SETS

OF ANY CAPACITY—FOR ALL CLASSES OF SERVICE

Bulletin 1090-AW shows many of these sets. Write for a copy.

Allis-Chalmers Manufacturing Company, Milwaukee, Wis.



STATES POTENTIAL PHASE SHIFTERS

—are used to test meters at fractional power factors. No skill is required to operate this apparatus—just turn the pointer to the position indicating the desired power factor.

Once this pointer is set the power factor will remain constant—unaffected by changes in the amount of current through the meter.

Hence, with the States Potential Phase Shifter, it is a simple matter to

Test Any Watt-Hour Meter at Any Power Factor

With the Potential Phase Shifter the test is made with an ordinary non-inductive load. The desired power factor conditions are obtained by turning a dial.

For testing meters at fractional power factors a States Potential Phase Shifter is the ideal instrument.

You'll say so too after reading Circular No. 27. Write for it.

THE STATES CO., 19 New Park Ave., HARTFORD, CONN.

Do You Want Both Quality and Service?

THEN ORDER NOW

40 Kva. 2200 Volt, 60 cycle, Single Phase, A-B Transformer

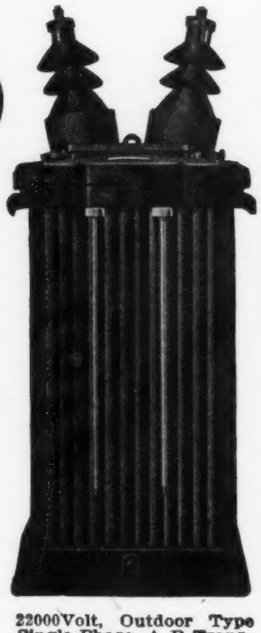
Adams-Bagnall

Distributing and Power Transformers

A-B transformers are always:

Safe in insulation;
Economical to operate;
Rugged and liberally designed;
Carefully manufactured;
Uniformly successful in operation.
Consistently a quality product backed by service.

If you are not getting A-B transformers just now, be sure to buy some. They make good. Ask us.



22000Volt, Outdoor Type Single Phase, A-B Transformer

The Adams-Bagnall Electric Co., Cleveland, Ohio

Manufacturers of Electrical Apparatus of Merit: { Industrial, Commercial and Street Lighting, Abolites. Lighting, Power and Constant Current Transformers. Gyrofans; Oscillating Fans; Auto Electrical Accessories.

TURBO GEAR

FAST PATENTS

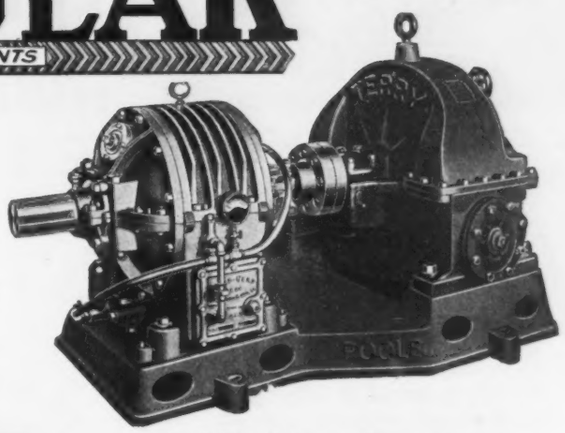
the 98% efficient speed transformer

stepping down from a turbine speed of 3600 to a speed of 440 for the driven unit.

The speed ratio of the Turbo-Gear may be anything from 4:1 up.

And as for range of speed, the Turbo-Gear is suitable for any speed up to and including 6000 RPM.

The high economy of the steam turbine is turned to account with the Turbo-Gear, as it permits the turbine to run at high speeds. So, too, with motor drive, the Turbo-Gear makes it possible to use a higher speed, less expensive motor.



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Manufacturers of Gears and Power Transmission Machinery Since 1843

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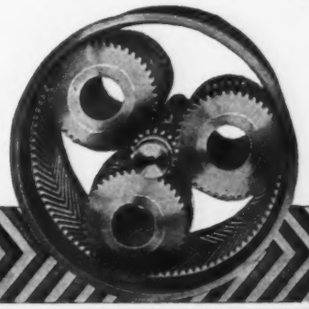

Do You Doubt?

That Rollway Bearings will not Overheat—

That they will outlast the Motor—

That we stand back of our product—

That we make good?

60 Days' Trial At Our Expense

Look at This Plate

RAILWAY ROLLER BEARING COMPANY

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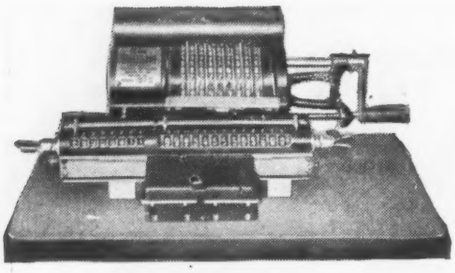

Never Before So Great a Demand for Marchant Calculators!

The Engineer needs the Marchant Calculator. It outranges the slide rule, and instead of being approximate, is *absolutely accurate*. Public Service Corporations, large mining cnd industrial companies, banks, commercial institutions, state, county and municipal offices find the Marchant invaluable. In *all* places in which time is spent in multiplying and dividing, much of it is MISspent unless a Marchant Calculating Machine is used.

Why? The need of conserving man power is today more vital than ever before.

And a Marchant Calculatar enables *one* man—or boy or girl, to do the work of *several* in any kind of multiplying or dividing. It is human in its range of usefullness, superhuman in its speed nnd accuracy.

The additions to the Marchant factory,t Oakland, California, which will treble the already large Marchant capacity, are practically complete.

We ask the indulgence of our fast increasing body of customers for any small delay in filling orders for the very short period necessary for us to bring capacity up to demand.

Marchant Calculating Machine Co., Emeryville, Oakland, Cal.

Special Eastern Representative: 585 Drexel Building, Philadelphia, Pa.

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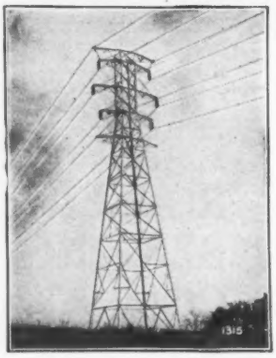
HUDSON TERMINAL-30 CHURCH STREET, NEW YORK

Manufacturers of Steel Structures of all classes particularly BRIDGES AND BUILDINGS



Transmission Towers, Pittsburgh, Pa.
Duquesne Light Co.

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made
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VUL-COT FIBRE

(a higher development of vulcanized cotton fibre)

Vul-Cot **Fibre has become nearly indispensable in electrical work, because it is a good insulator; because of the ease and accuracy with which it can be turned, drilled, tapped, threaded or stamped, and because of its economy and long wearing qualities.**

Vul-Cot **Fibre has all the good qualities of insulators such as glass, porcelain, mica and hard rubber, but none of the disadvantages of brittleness, liability of breakage, difficulty of machining, etc.**

In electrical instruments and machines, from household appliances to giant motors and dynamos, you will find this durable and efficient material serving in some of its myriad forms.

Tell us of your requirements, and we will advise you frankly whether or not *Vul-Cot* Fibre is best suited for the work you have in mind. Samples will accompany our report. Write today.

AMERICAN VULCANIZED FIBRE CO.
560-570 Equitable Bldg., Wilmington, Delaware

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BOSTON PHILADELPHIA CLEVELAND CHICAGO
NEW YORK PITTSBURGH DETROIT ST. LOUIS

Complete stock for immediate shipment at Chicago

CANADIAN AGENTS *Northern Electric Company* LIMITED

Montreal, Ottawa, Halifax, Toronto, Winnipeg, Calgary, Regina, Vancouver

Kudha

Some Hindu pilgrims roll their bodies on the earth many miles to a distant shrine—up hill and down dale and through the village streets. Everywhere traffic gives them the right of way so that they may have every opportunity to roll their way to salvation (kudha).

Rolling is one way to get there, but it's a rough, rocky way and takes a long time.

We cannot consistently laugh at the poor pilgrim because we see about us every day seekers for salvation from carbon brush troubles doing practically the same thing.

They grope. They try sandpaper, lubricant and other patent medicine methods.

However, in justice to the thinking brush users, we must admit that many adopt the direct course of riding comfortably to kudha through a prescription of Morganite brushes—the through express—without change. Get aboard.

The Morgan Crucible Company

Main Office and Factory:
519 West 38th Street, New York City

DISTRICT AGENTS:
Lewis & Roth, 1012 Liberty Bldg., Philadelphia
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Dear Boss:
For the New Year map me out a bigger program of Driver-Harris Service.

I realize that if I keep on in my same old way with the same old effort that it will take a long, long time for Miss Democracy to win the international hand and heart.

We've got a job on hand now of feeding two worlds instead of one—and **some** men must work overtime or with doubled effort.

I want to be one of them.

And I realize that to be the only way to make A HAPPY as well as PROSPEROUS year of 1918.

Nye Chrome

DRIVER-HARRIS COMPANY
CHICAGO 28 So. JEFFERSON ST HARRISON, N.J. MANCHESTER ENGLAND

Use Pittsburg No. 165½ Porcelain Insulators for 35,000 Volts

One of the many different Pittsburg insulator designs for telephone use up to 80,000 volts.
Each type is designed and constructed to meet particular requirements. Let our engineers help you select the Pittsburg, which meets your requirements.
For maximum safety specify Pittsburg.

The Pittsburg High Voltage Insulator Co.

Main Office and Factory, Derry, Penna.
Westinghouse Electric & Mfg. Company, East Pittsburgh, sole agent for United States.
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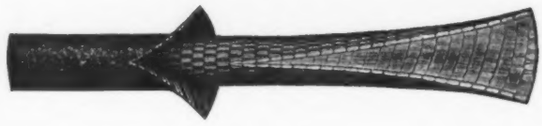
Harmon S. Salt, 114 Liberty Street, New York, Export Agent.

"LOOMFLEX"
Flexible Conduit



Why consider the destructible when you can have the indestructible?

No matter how badly crushed, twisted or kinked, "Loomflex" can always be pinched back into shape and used. Easy to fish—all sizes are slightly oversized and there are no seams to break loose. The roller-bearing construction of the interior allows the wire to slide through with a minimum of friction.

Write for samples.

AMERICAN CIRCULAR LOOM CO. TRADE MARK

American Circular Loom Co.
90 West St., New York
Boston Los Angeles Seattle
Chicago San Francisco Toronto

1

Place your thermometer on any part of the windings

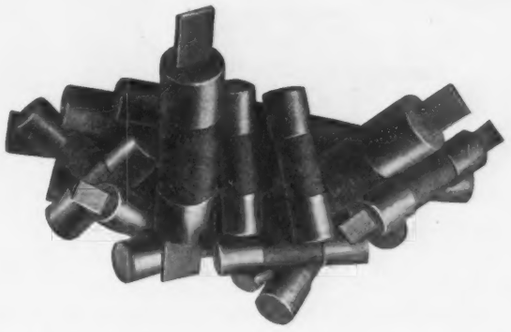
PEERLESS TRANSFORMERS

Test the uniform temperature rise of Peerless Transformers *yourself*—we'll send you one for trial. Prove its efficiency in your own plant. Let *performance* not "patter"—sell you a PEERLESS. Ask us about our free trial proposition. Write NOW.

The Enterprise Electric Co.
Warren, Ohio

6

THE WAR ON WASTE



One of the resultants of the mobilization of our industries is a nation-wide war on waste.

The Daum Refillable Fuse may be used over and over again by replacing with a new fuse element which can be quickly torn from a Daum Fuse Strip and inserted in the fuse.

The Daum Fuse Strip is very inexpensive and is put up in very convenient box form.

Send for free sample and descriptive literature.

SOLE MANUFACTURER

A. F. DAUM
PITTSBURGH, PA., U. S. A.

Beldenamel
TRADE MARK

MAGNET WIRE

THE "STANDARD" FOR ENAMELED WIRE

An Insulation which will withstand the most severe tests.

Made in Wire as large as No. 7 B. & S. Ga. and as small as No. 48 B. & S. Ga. (.0015").

Has four times the dielectric strength of cotton or silk insulation of same thickness.

With a 36 Wire it gives 60% more turns per sq. in. over single silk insulation.

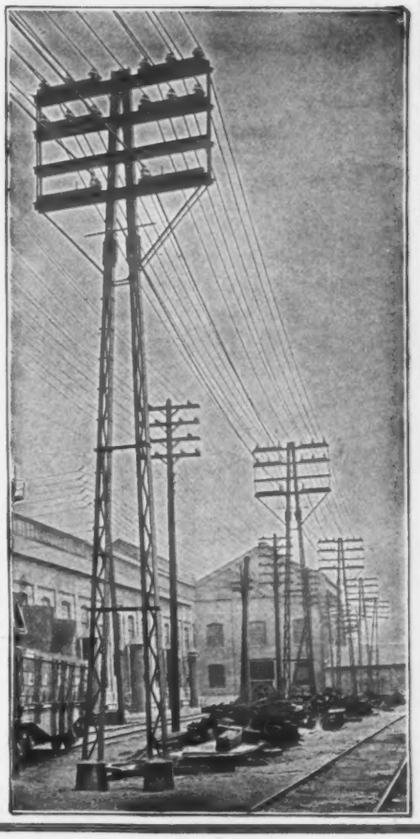
Belden Manufacturing Co.
2301 S. Western Ave.
CHICAGO

STEEL POLES
For Every Pole Purpose

Cut shows Bates A-Frame Steel Poles in use by the Illinois Steel Co., South Chicago, Ill. This line is designed to carry 25 one million circular Mills conductors for industrial service.

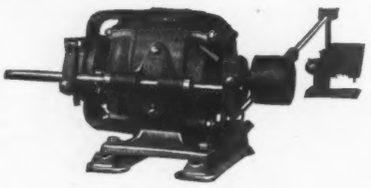
Bates Steel Poles are becoming universally popular world wide. Repeat orders testify their general suitability for every Pole purpose, Telegraph, Telephone, Power Transmission, Electric Trolley Lines, Electric Lighting, etc. Highest class and most up-to-date steel pole equipment in the world. Our STEEL POLE TREATISE tells the story. Ask for it.

About 2000 tons of steel constantly on hand; immediate shipments and lowest prices.



Bates Expanded Steel Truss Company
208 So. La Salle St.
Chicago, Ill.

IMMEDIATE DELIVERY



of these New Type BSS Motors.

We have in stock a sufficient supply of the above

SINGLE PHASE MOTORS

to fill your orders at once.

Sizes ¼ to 1 h.p. inclusive, 60 cycles, 110 or 220 volts, varying speed with foot or hand control, especially adapted for driving all kinds of small machinery requiring variable speed, small presses and allied machines.

Send for Prices and Bulletin No. 41514

SPRAGUE ELECTRIC WORKS
OF GENERAL ELECTRIC COMPANY
Main Offices:
527-531 West 34th Street, New York, N. Y.
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Telephone Wire IN STOCK

Ready for shipment

19 B & S 3/32 Ins. Twisted Pair, Tan or Olive
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18 B & S 7/64 Ins. Twisted Pair Bridle Wire
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Made in accordance with Hazard Standards which are absolutely dependable.

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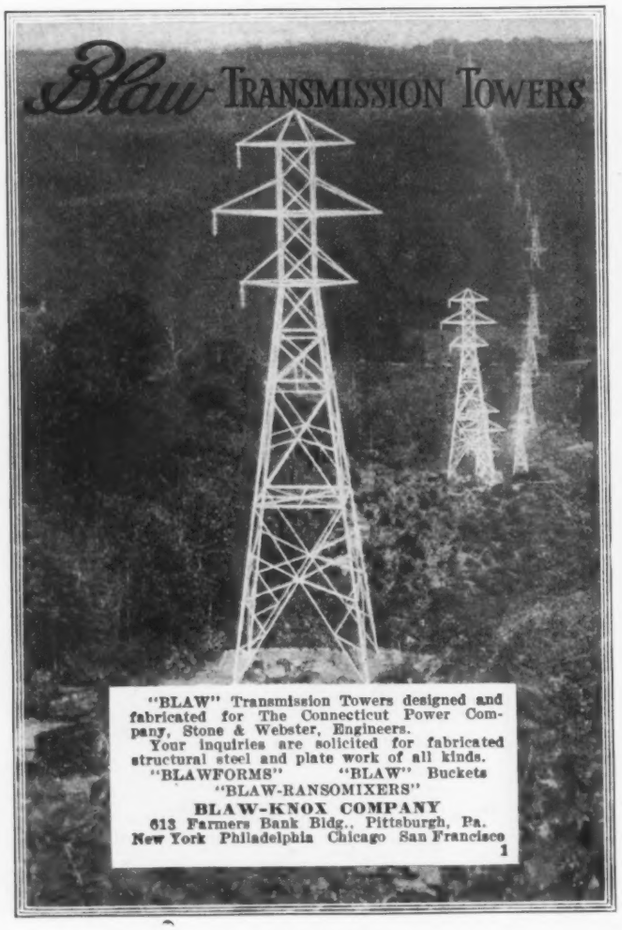

"BLAW" Transmission Towers designed and fabricated for The Connecticut Power Company, Stone & Webster, Engineers.
Your inquiries are solicited for fabricated structural steel and plate work of all kinds.
"BLAWFORMS" "BLAW" Buckets
"BLAW-RANSOMIXERS"
BLAW-KNOX COMPANY
613 Farmers Bank Bldg., Pittsburgh, Pa.
New York Philadelphia Chicago San Francisco
1

In Damp Atmosphere

The fibre casing of the "MULTI" Refillable Fuse does not swell and prevent disassembling —the closing cap screws on a *brass ferrule.* It saves time on refilling and insures the long life of the fuse casing.

"MULTI" Refillable Fuse

more than pays for itself on the fifth burn-out and can be *refilled indefinitely at 5% of the old style fuse cost.*

The "Refills" are accurate—N. E. C. Standard Rating—and afford protection for your equipment and plant.

Write for a sample—we'll send it at once.

MULTI REFILLABLE FUSE CO.
803 WEST MADISON ST., CHICAGO

MULTI

The One Reliable Ground

There is just one ground that you can always depend upon, one ground that always protects. And that is the

PARAGON Ground Cone

Paragon Cones never fail, no matter how severe the shock, because they are built on the right principle. Low in first cost, simple and economical to install, with no maintenance expense, they cost less than any other ground you could use.

WRITE FOR COMPLETE DESCRIPTION

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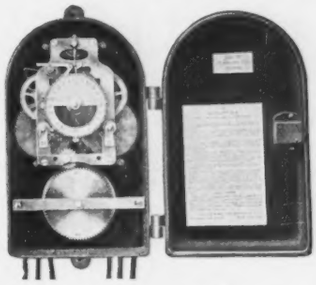
3. S. Clinton St., CHICAGO

526 First Ave., S., Seattle, Wash.
212 W. Third St., Los Angeles, Calif.
86 Third St., San Francisco, Calif.
Northern Electric Co., Ltd.,
Canadian Distributors



UNCLE SAM SAYS—

"Electric Signs Must be Turned Off at 11 O'Clock EVERY Night"

THE Hartford Time Switch

Never Forgets Its Job

For Durability, Accuracy and Reliability in turning on and off, at any specified time, the current for show window or Sign Lighting—the Approved Way.

"Wind It Once a Week—That's All."

The Hartford Time Switch Co.
A. HALL BERRY, General Sales Agent

71 Murray Street NEW YORK
9 So. Clinton Street CHICAGO

TUNG-SOL Automobile Lamps

Tung-Sol Nitrogen Headlight

THE fact that Tung-Sol automobile headlight lamps meet the requirements of the Society of Automobile Engineers as to focus means that you can sell lamps that have real talking points—real quality lamps with right price and prompt delivery.

Miniature Lamp Works
Independent Lamp & Wire Co., Inc.
Weehawken, N. J.

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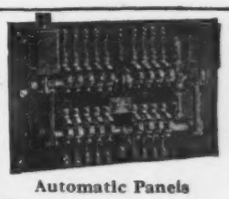
Solenoid operated —up to 2500 amps.



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We are originators of this type of automatic lighting panel.

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A.C. D.C.

If you have an electrical control problem, put it up to SUNDH. We are specialists and have made remote control our life study and work. Many important installations testify to the quality of SUNDH Service. Want the names?

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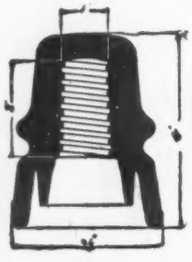

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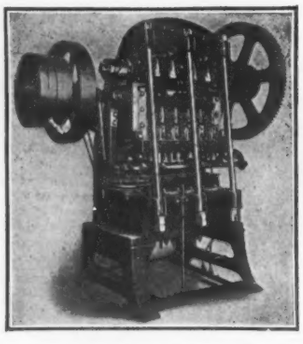

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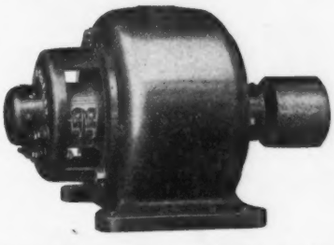

can now be made in a large variety of ratings. Other ratings can be shipped promptly.

Greatly increased production facilities enable us to manufacture these popular motors in greater quantities than ever before.

Constant speed type: 1/5 to 7.5 H.P., 110, 115, 220, 230 and 550 volts, shunt or compound wound. Variable-speed type: .35 to 3.75 H.P., 115 and 230 volts.

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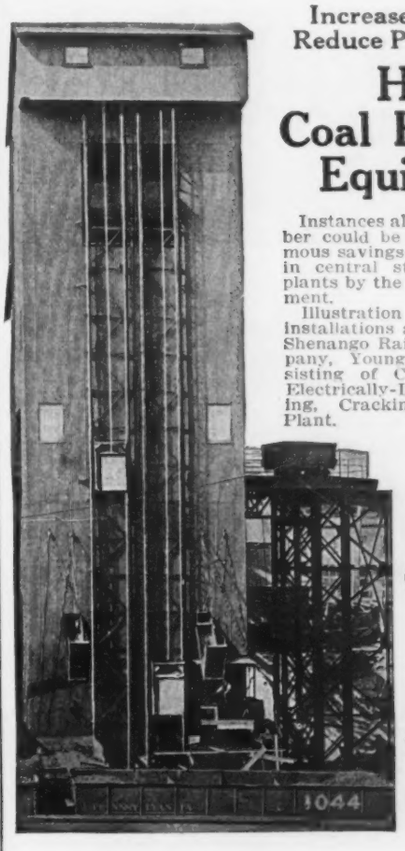

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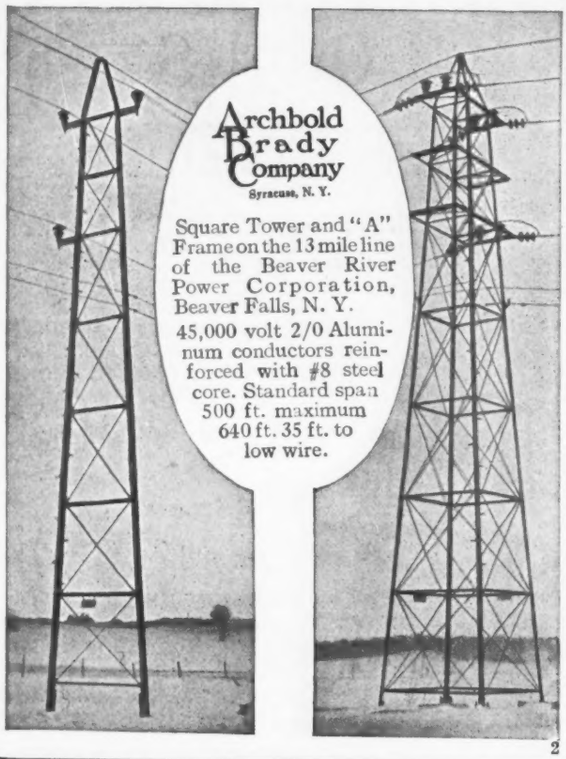

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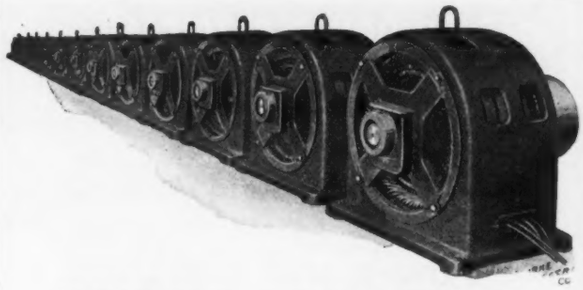

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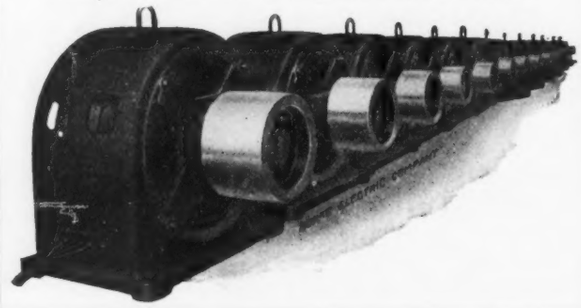
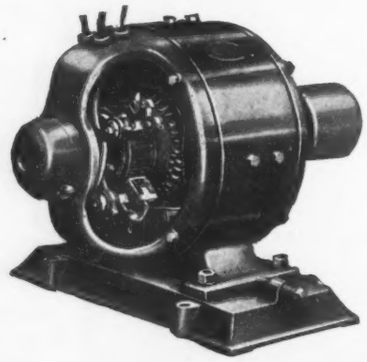


WATSON MOTORS



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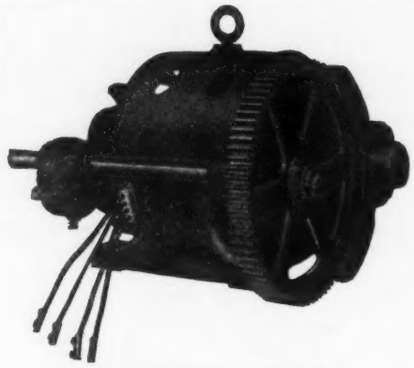

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SINGLE PHASE MOTORS

Ring oiling phosphor bronze bearings throughout.

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Licensed under General Electric Co. Patents

COURT HOUSE, TRENTON, N. J.

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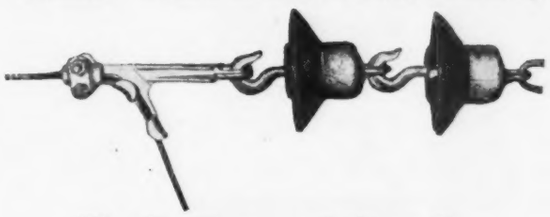
LAST LONGEST

This Thomas Assembly for Moderate Strains and Voltage up to 13,000



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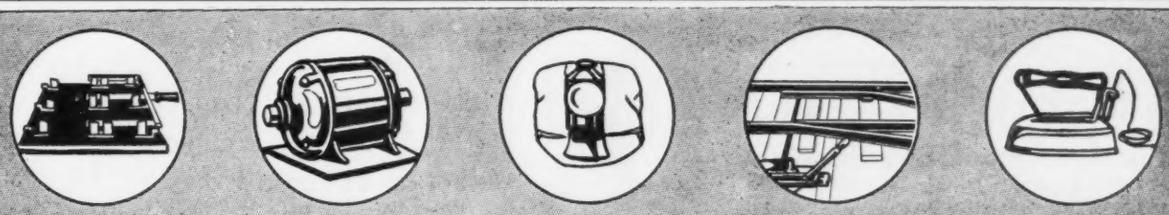

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100-125 Volts

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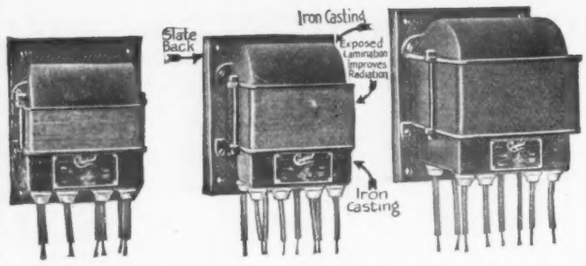

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The quality of KUHLMAN Transformers arises from the finest materials, the best equipment and the skill of experienced workmen, *PLUS* the loyally supported spirit of our plant, i.e.—the determination to make KUHLMAN QUALITY *supreme.*

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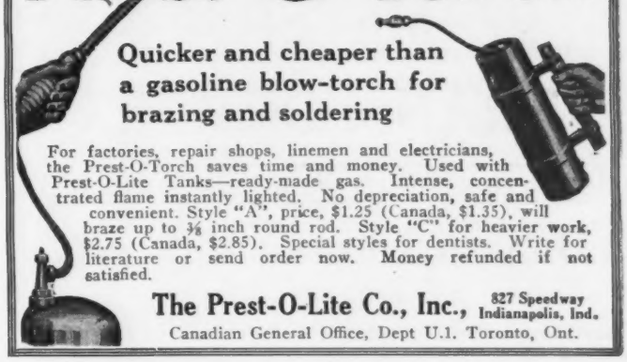

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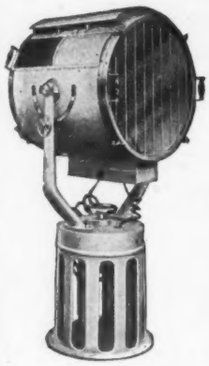

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Insulators:

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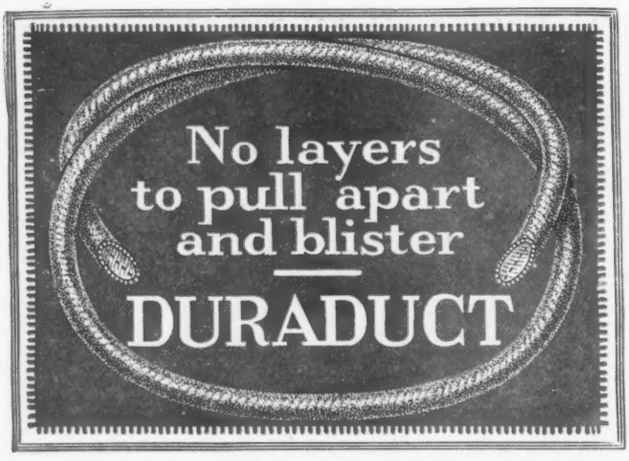

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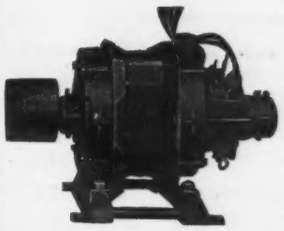
6

Kimble A. C. Motors

Variable Speed Single Phase



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They greatly increase the production of each press.

Tell it to printers.

There's money in it for you and for them.

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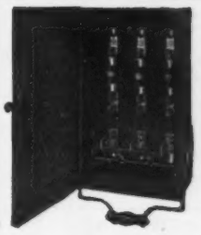

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—of the right quality
—at the right price
—from

Consolidated Electric Lamp Company

Tapleyville Station
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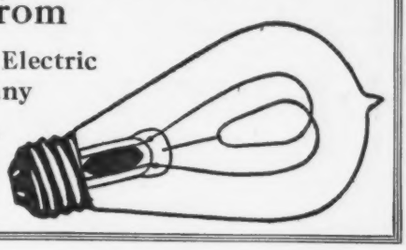

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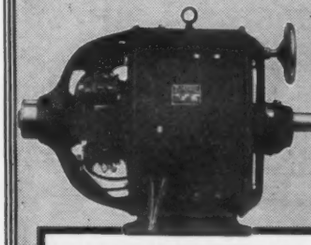

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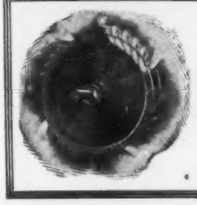

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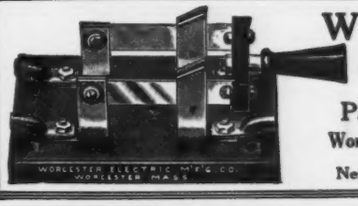

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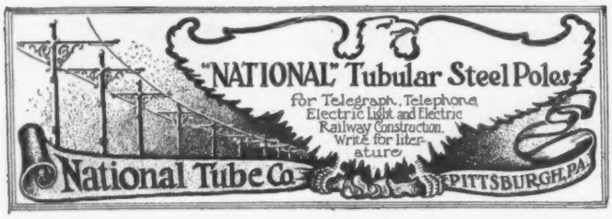
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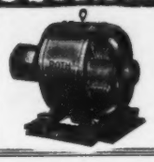

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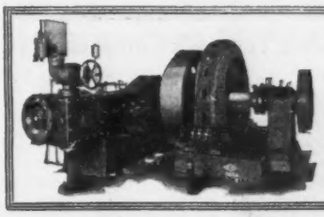

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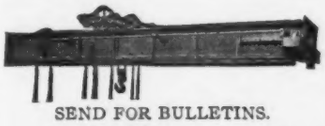

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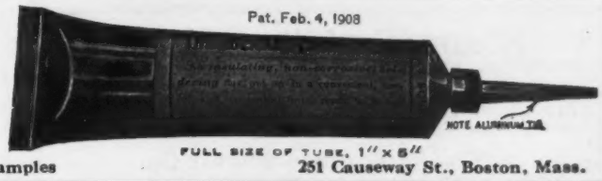

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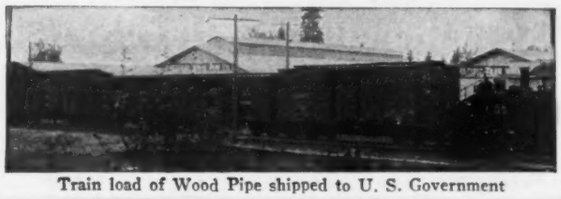

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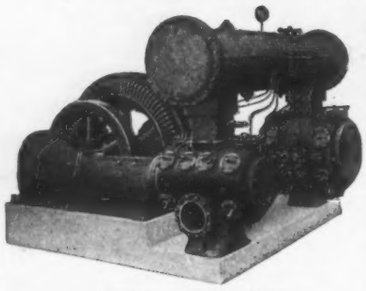

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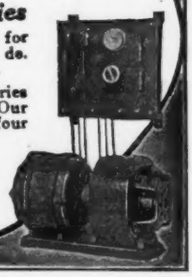

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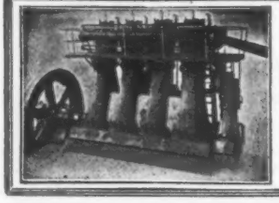

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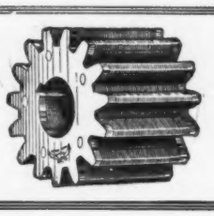

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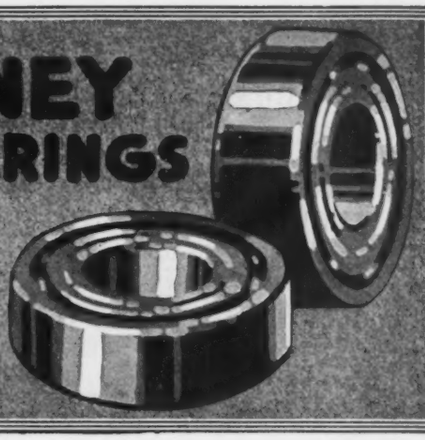

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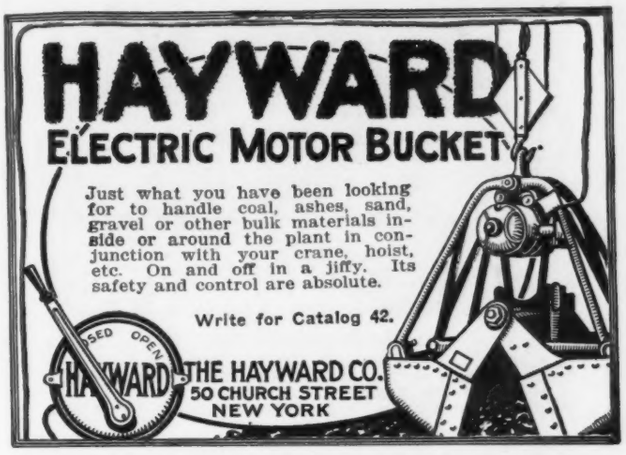

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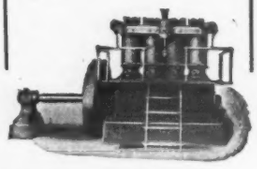

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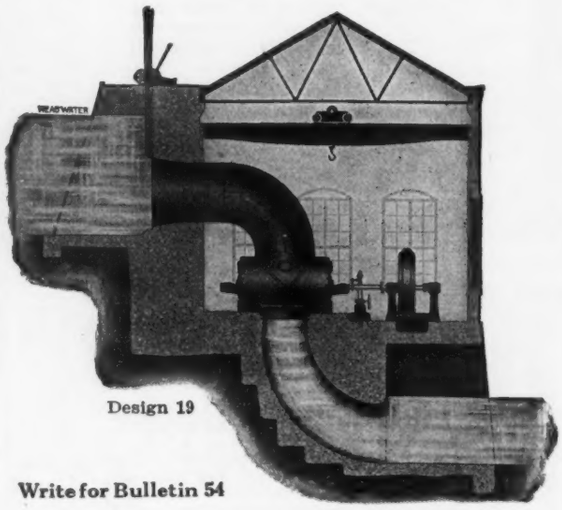

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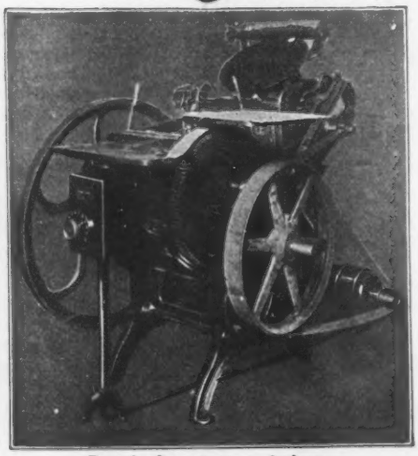
⅓ H. P. Variable 10" x 15" Chandler & Price Job Press

Motor belted to a



Don't be too credulous

We'll send you an A K Push Button Control Motor and let you try it out for 30 days. If it doesn't make good send it back—but it will. The advantages of set speeds, dynamic brake, no voltage release—mean operation that you'll appreciate on your constant torque loads—and the first cost is actually less than drum or face plate type control. A. C. or D. C.—any cycle—1/20 to 6 h.p. Drop us a line. 916

Northwestern Electric Co.

Manufacturers of "Martin" Rotary and Motors,

408-416 S. Hoyne Ave., Chicago, Ill.
New York: 1457 Broadway. Minneapolis: 8 N. Sixth St. Toronto: 808 Tyrrell Bldg., 95 King St., E. Topeka, Kansas: 425 Jackson. Kansas City, Mo.: 501 Waldheim Bl.

THE SMITH HYDRAULIC TURBINE

here illustrated consists of a single vertical shaft Wicket Gate Turbine, in cast iron scroll case, direct connected to vertical shaft generator, developing 400 H. P., 450 R. P. M. under 45 feet head.

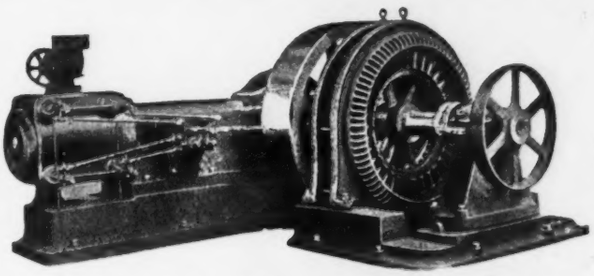
THIS VERY COMPACT UNIT NOW IN SUCCESSFUL OPERATION AT NORTHWESTERN CONSOLIDATED MILLING CO. MINNEAPOLIS, MINN.

If interested, write Dept. W for Bulletin.

S. MORGAN SMITH CO., YORK, PA.

Branch Offices: BOSTON 176 Federal St. | CHICAGO 76 W. Monroe St. | MONTREAL 405 Power Bldg.

SPRAY
AIR WASHER
AMERICAN SPRAY CO.
25 CHURCH ST., NEW YORK
ADOPTED BY LARGEST POWER USERS



Aside from their efficiency, quiet operation and economy, these Units are preferred wherever absolute dependability is essential.

NO "ADJUSTING" is necessary when you install
RIDGWAY UNITS
They are made for each other
Write for our Bulletins
Ridgway Dynamo & Engine Co.
Ridgway, Pa.
2

Read that article →

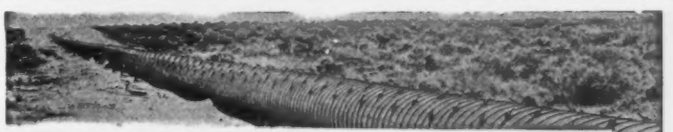
Then remember that we make perfect

Continuous Stave Wood Pipe and Machined Banded

in all sizes, for Power Plants and for Water Works. Catalog, prepared by well-known engineers, sent on request.

Washington Pipe & Foundry Co.

TACOMA, WASH., U. S. A.
New York Office, Woolworth Building



Wood Pipe Ages Less Than Iron or Steel

Based both on theoretical investigations and on field tests, the author of Bulletin 376 of the U. S. Department of Agriculture concludes that wood pipe will convey about 15 per cent more water than a ten-year-old cast-iron pipe or a new riveted pipe, and about 25 per cent more than a cast-iron pipe twenty years old or a riveted pipe ten years old.—*Engineering Record, March* 31, 1917.

COOLING PONDS

reach their highest efficiency only when equipped with "Spraco" patent nozzles because their *double jets* (center flow and rotary) combine to produce a complete "bouquet" atomization—not a cone spray as with ordinary nozzles.

Get our new bulletin which tells how and why the "SPRACO" nozzle gives you *twice* the cooling power with *half* the water.

The Spray Engineering Co.
93 Federal St., Boston, Mass.
2

Getting

The Taylor Stoker

Your Point of View

Said the Sales Manager of the American Engineering Company to the TAYLOR Stoker Advertising Man, "I want you to call on the Chief Operating Engineer of the ———— Company and ask him to tell you exactly why his company installed our TAYLOR *Power Dump* Stokers. Then write an ELECTRICAL WORLD advertisement based on that interview and let him tell the story. Our readers want the user's viewpoint, and we'll print what he says the way he says it."

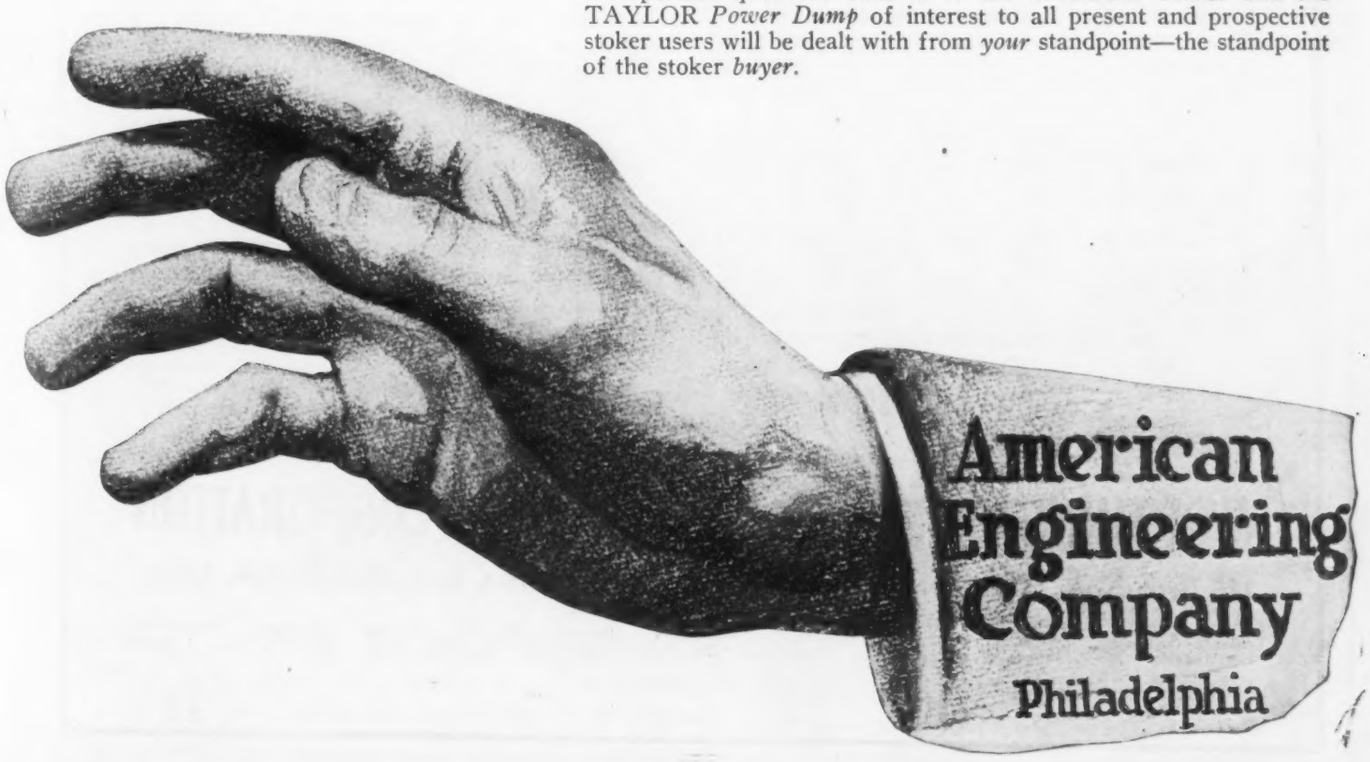
Seated in the private office of the Chief Operating Engineer of one of the country's greatest public utility companies, the TAYLOR Stoker Advertising Man put the question: "Why did you install the TAYLOR *Power Dump* Stoker in your plants?

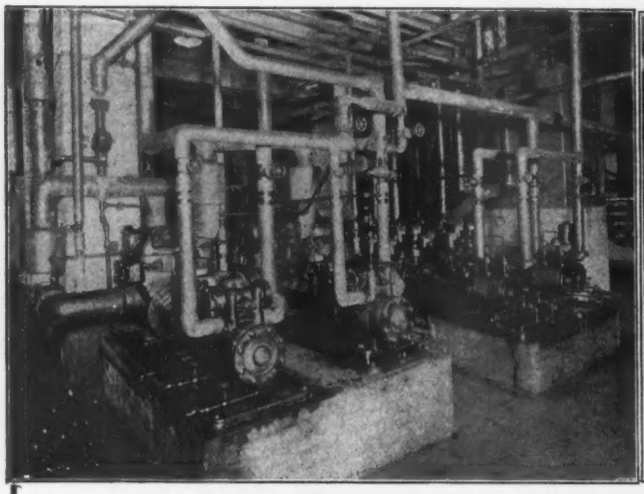
"The boiler firing problems that you must solve are identical with those with which practically all of the larger Central Stations of the country are now confronted. What we want to publish is why you picked the TAYLOR *Power Dump* Stoker as the answer to your problem."

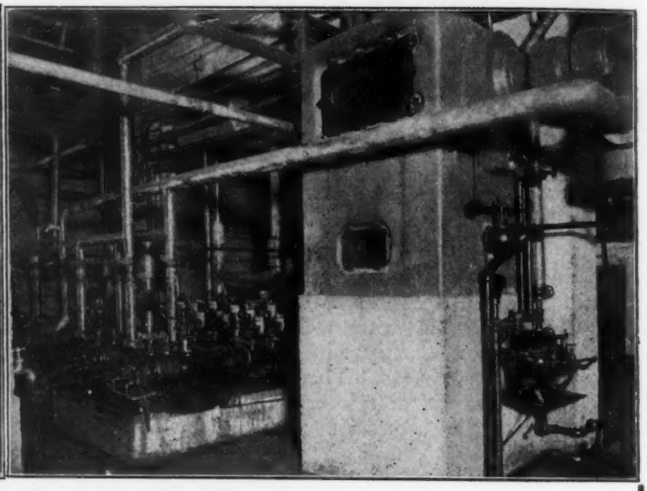
The reply of the Chief Operating Engineer to the above question will be given in our ELECTRICAL WORLD advertisement next week.

This advertisement will be the first of a series based on practically verbatim reports of actual interviews with operating engineers using the TAYLOR Stoker.

Important questions relative to the TAYLOR Stoker and the TAYLOR *Power Dump* of interest to all present and prospective stoker users will be dealt with from *your* standpoint—the standpoint of the stoker *buyer*.







View in Boiler Room of City Hall Annex, Boston, Mass.

Two Blake-Knowles 8x12x12 Simplex Steam Heating Vacuum Pumps

This picture shows the 750-H.P. Blake-Knowles Open Feed Water Heater, with its attendant boiler feed pumps

THE BLAKE-KNOWLES EQUIPMENT

for heating and boiler feeding in the

BOSTON CITY HALL ANNEX

Two Simplex Pumps
Two Heavy Pressure Pumps
One 750-H.P. Open Feed Water Heater

The Blake-Knowles installation consists of two Blake-Knowles Simplex Style "A" Steam Heating Vacuum Pumps, size 8 x 12 x 12, two Blake-Knowles Duplex outside packed plunger Boiler Feed Pumps of the Pot Valve style, size 7½ x 4½ x 6, and one Blake-Knowles 750-H.P. Open Feed Water Heater.

The battery consists of three 250-H.P. Babcock & Wilcox Boilers, carrying 125-lbs. steam pressure, two of which are in constant use, the third being held as a reserve. One pump only is required for feeding the boilers, the other being a reserve. The Feed Water Heater is arranged on the "induction" principle, that is, takes a sufficient amount of exhaust steam from the exhaust line for heating the feed water used by the boilers, which it raises to a temperature of from 208° to 214°, still leaving an ample quantity of steam in the exhaust line for heating all the buildings which it serves. A back pressure of about two pounds is carried on the line. The steam heating vacuum pumps remove all the air and vapors from the coils of the entire heating system of the buildings, one pump only operating regularly.

The installation is a well arranged and completely equipped outfit which has given perfect satisfaction from the start. It has been in active service for about three years, working night and day, and during this time it has not required repair nor does it yet show signs of wear.

Bulletin describing type of machinery you are interested in will be sent on request.

WORTHINGTON PUMP AND MACHINERY CORPORATION

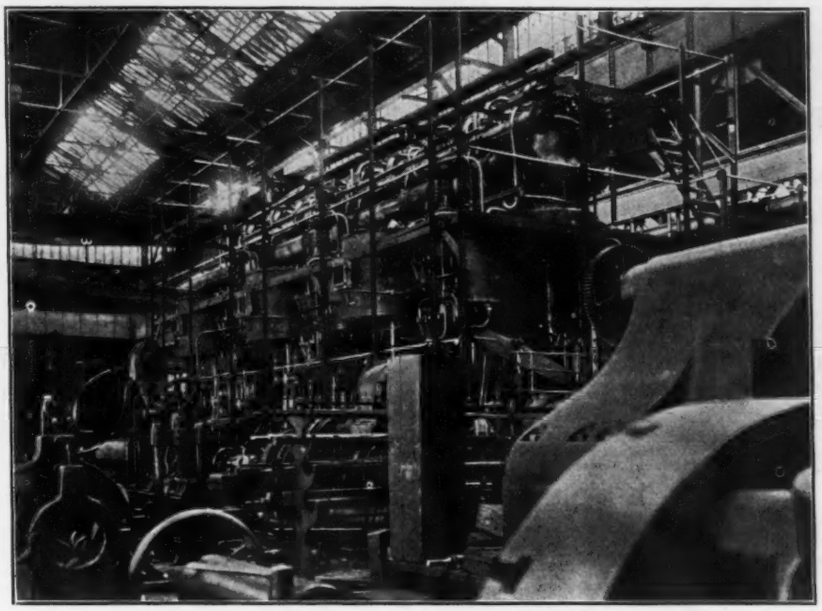
115 Broadway, New York **Blake & Knowles Works, East Cambridge, Mass.**

BRANCH OFFICES

Atlanta Boston Buffalo Chicago Cincinnati Cleveland Denver Detroit El Paso Houston Kansas City
Los Angeles New Orleans Philadelphia Pittsburgh St. Paul St. Louis Salt Lake City San Francisco Seattle

B296.8

TEXACO URSA OIL



TEXACO URSA OIL

ENGINES OF THE U. S. S. "MAUMEE"

The Largest Diesel Engines in the World

LAST week we showed this picture of the engines of the U.S.S. "Maumee," giving some data as to the size of these two 2500 H.P. Diesel engines.

We told you how these engines were tested on the block and then taken down to be set up in the hull of the ship.

While these engines were in the dismantling process, we had the opportunity of observing some interesting items.

The engines had been left standing for a month. Our experts were present as they were being taken down, and they had an excellent opportunity to observe the extraordinary effects of lubrication with

TEXACO URSA OIL

for this class of work. The cylinder walls were in perfect condition, without a trace of carbon. The walls were so well coated with URSA OIL that the pistons were extracted with the greatest ease, and the rings moved freely in the grooves.

You can realize after this report why URSA lubricated Diesels always start without stress or labor. This clean, perfect and lasting lubrication of cylinders, rings and bearings is but one of the reasons why so many manufacturers of Diesel and other heavy oil engines regard URSA as a "find"—why they are more than pleased to recommend it for use on their engines. But the real practical reason for using TEXACO URSA OIL on your engine is the fact that TEXACO URSA OIL TAKES CARE OF ALL THE PARTS—ONE OIL FOR ALL. It lubricates the power cylinders and air compressers and all the bearings.

This means efficiency. Less oil is required and freedom from the danger of admixture of use of wrong oil is insured. The same high grade lubrication is maintained in all places at all times.

Remember also that URSA does not distill or decompose in the combustion chamber. It burns cleanly and never deposits hard carbon.

We are glad at all times to supply prices and further information on TEXACO URSA OIL or any lubricants for any purpose whatever. You may be interested in our monthly publication, "Lubrication," which deals with items of general interest on the lubrication of all kinds of engines and machines. It is a little 16-page publication and well worth reading. We will be glad to put you on the free mailing list. Fill out the coupon.

The Texas Company, Dept. L1,
17 Battery Pl., New York City.

Please send me your magazine "Lubrication" free monthly.

Name .....

Firm Name .....

Address .....

City ..... State .....

12-29

THE TEXAS COMPANY

Dept. L1, 17 Battery Place, New York City

HOUSTON CHICAGO NEW YORK

Offices in Principal Cities

There is a Texaco Lubricant for Every Purpose

WHAT AND WHERE TO BUY

Equipment, Apparatus and Supplies Used by the Electrical Industry with Names of Manufacturers and Distributors

Acetylene in Cylinders.
Prest-O-Lite Co., Inc.

Air Compressors.
Allis-Chalmers Mfg. Co.
General Electric Co.
Worthington P. & M. Corp.

Air Washers and Coolers.
American Spray Co.
Spray Engrg. Co.

Aluminum.
Aluminum Co. of America.

Ammeters, Voltmeters. (See Instruments, Electrical.)

Anchors, Guy.
Hubbard & Co.
Matthews & Bro., Inc., W. N.

Armature Disks and Segments.
Bliss Co., E. W.

Batteries, Dry Cell.
Amer. Ever Ready Wks.
Western Elec. Co.

Batteries, Primary.
Manhattan Elec'l Supply Co.

Batteries, Storage.
Edison Storage Battery Co.
Electric Storage Battery Co.

Battery Charging Apparatus.
Cutler-Hammer Mfg. Co.
General Elec. Co.
Lincoln Elec. Co.

Battery Charging Sets, Mot.-Gen.
St. Louis Elec'l Works.

Bearings, Ball.
Gurney Ball Bearings Co.
Norma Co. of America.
S K F Ball Bearing Co.

Bearings, Roller.
Railway Roller Bearing Co.

Bells.
Manhattan Elec'l Supply Co.

Blast Furnaces.
Riter-Conley Co.

Blowers, Steam Driven.
Terry Steam Turbine Co.

Boilers, Steam.
Babcock & Wilcox Co.
Edge Moor Iron Co.

Bolts, Expansion.
Hubbard & Co.

Bond Testers.
Roller-Smith Co.

Books, Technical.
McGraw-Hill Book Co., Inc.

Boosters.
Crocker-Wheeler Co.
General Electric Co.
Ridgway Dynamo & Eng. Co.
Triumph Electric Co.
Westinghouse Elec. & Mfg. Co.

Boxes, Fuse.
Electric Fuseguard Co.
General Electric Co.
Matthews & Bro., Inc., W. N.
Metropolitan Eng'g Co.

Boxes, Junction and Outlet.
Chicago Fuse Mfg. Co.
D & W Fuse Co.
Electric Fuseguard Co.
General Electric Co.
National Metal Molding Co.
Sprague Electric Works.

Boxes, Meter and Service.
General Elec. Co.
Metropolitan Eng'g Co.
Wadsworth Elec. Mfg. Co.

Brackets and Pins, Metal.
Hubbard & Co.
Pittsburgh Transformer Co.

Brushes, Dynamo.
American Carbon & Battery Co.
General Elec. Co.
Jeandron, W. J.
Morgan Crucible Co., Ltd.

Buildings, Steel.
Blaw-Knox Co.

Buckets, Excavating, Motor-Driven.
Hayward Co.

Bushings.
Condit Electrical Mfg. Co.
Diamond State Fibre Co.
National Metal Molding Co.

Cable End Bells.
Cope, T. J.
Elec'l Engineers Equipment Co.

Cable Racks.
Cope, T. J.
Elec'l Engineers Equipment Co.
Hubbard & Co.
Metropolitan Eng'g Co.

Cable Splicing Joints.
Elec'l Engineers Equipment Co.
Frankel Connector Co., Inc.

Cable Winches.
Cope, T. J.

Cabling Machinery.
American Ins. Machinery Co.
New England Butt Co.
Torrington Mfg. Co.

Carbon Brushes.
American Carbon & Battery Co.
Jeandron, W. J.
Morgan Crucible Co.

Cars, Coal & Ash Handling.
Easton Car & Const. Co.

Castings.
Triumph Elec. Co.

Castings, Die.
Acme Die Casting Corp.
Doehler Die-Casting Co.

Circle Shears for Armature Disks and Segments.
Bliss Co., E. W.

Circuit Breakers.
Auto Reclosing Circuit Breaker Co.
Condit Electrical Mfg. Co.
Cutter Co., The.
General Electric Co.
Industrial Controller Co.
Roller-Smith Co.
Sangamo Elec. Co.
Sundh Elec. Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.

Clamps, Cable Supporting.
Matthews & Bro., Inc., W. N.
Elec'l Engineers Equipment Co.

Clamps, Ground Connections.
Frankel Connector Co., Inc.
General Electric Co.

Clamps, Guy.
Hubbard & Co.
Matthews & Bro., Inc., W. N.

Clamps, Insulator.
Clark Insulator & Mfg. Co.
Elec'l Engineers Equipment Co.

Cleats.
Blake Signal & Mfg. Co.
General Electric Co.
Imperial Porcelain Works.
National Metal Molding Co.
Thomas & Sons Co., R.

Clips, Cable.
Hubbard & Co.

Clips, Testing.
Mueller & Co., R. S.

Clusters.
Benjamin Elec. Mfg. Co.
Hubbell, Inc., Harvey.

Clutches, Magnetic.
Cutler-Hammer Mfg. Co.

Coal and Ash Handling Machinery.
Hayward Co.

Coils, Armature, Field.
D & W Fuse Co.
Doubleday-Hill Elec. Co.
General Elec. Co.
Independent Lamp & Wire Co.

Coils, Choke.
General Electric Co.

Commutators.
Cameron Electric Mfg. Co.
Doubleday-Hill Elec. Co.

Compounds, Commutator.
McLellen Co., K.

Conduit Bends.
Fibre Conduit Co.

Conduit Rods.
Cope, T. J.

Conduit Fittings.
Sprague Electric Works.

Conduits, Interior.
American Circular Loom Co.
National Metal Molding Co.
Sprague Electric Works.
Tubular Woven Fabric Co.
Ward & Goldstone, Ltd.

Conduits, Underground.
Fibre Conduit Co.

Connectors and Terminals.
Elec'l Engineers Equipment Co.
Frankel Connector Co., Inc.

Controllers, Motor.
Crocker-Wheeler Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Monitor Controller Co.
Sundh Electric Co.
Ward Leonard Electric Co.

Conveying Machinery. (Coal, Ashes, Etc.)
American Bridge Co.
Green Engineering Co.
Hunt Co., Inc., C. W.

Cooling Ponds, Spray.
American Spray Co.
Spray Engrg. Co.

Cord Adjusters.
American Vul. Fibre Co.
Diamond State Fibre Co.

Cord, Arc Lamp.
Samson Cordage Works.

Cord, Flexible.
Belden Mfg. Co.
General Electric Co.
Rome Wire Co.

Cord, Trolley.
Samson Cordage Works.

Couplings, Flexible.
Bruce-Macbeth Engine Co.
Smith-Serrell Co., Inc.

Couplings, Magnetic.
Cutler-Hammer Mfg. Co.

Crane Motors.
Crocker-Wheeler Co.
Sprague Electric Works.
Triumph Electric Co.
Westinghouse Elec. & Mfg. Co.

Cranes, Traveling.
American Bridge Co.
Maris Bros.

Cross Arms.
American Bridge Co.
Hubbard & Co.
Thomas & Sons Co., R.
Western Electric Co.

Cutouts.
D & W Fuse Co.
General Elec. Co.
Matthews & Bro., Inc., W. N.
Metropolitan Eng'g Co.

Cutting Apparatus, Oxy-Acetylene.
Prest-O-Lite Co., Inc.

Cutting Dies.
Bliss Co., E. W.

Dies, Wire Drawing.
European Co., The.

Drills, Brick.
Hubbard & Co.

Dynamos and Motors.
Allis-Chalmers Mfg. Co.
Burke Elec. Co.
Century Electric Co.
Crocker-Wheeler Co.
Electric Machinery Co.
Electro-Dynamic Mfg. Co.
Emerson Electric Mfg. Co.
General Electric Co.
Gregory Electric Co.
Kimble Electric Co.
Lincoln Electric Co.
Mechanical Appliance Co.
Reliance Elec. & Eng'g Co.
Ridgway Dynamo & Engine Co.
Robbins & Myers Co.
Roth Bros. & Co.
Sprague Electric Works.
Wagner Electric Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Economizers, Fuel.
Green Fuel Economizer Co.

Electromagnets.
Acme Wire Co.
Cutler-Hammer Mfg. Co.
Elec. Controller & Mfg. Co.
Ward Leonard Elec. Co.

Engineers, Consulting and Contracting.

(See also Directory of Engineers.)

Engines, Gas and Gasoline.
Allis-Chalmers Mfg. Co.
Bruce-Macbeth Engine Co.
Carlisle & Finch Co.
General Electric Co.
Worthington P. & M. Corp.

Engines, Oil.
Chicago Pneumatic Tool Co.
McIntosh & Seymour Corp.
Worthington P. & M. Corp.

Engines, Steam.
Allis-Chalmers Mfg. Co.
Ridgway Dynamo & Eng. Co.

Excavating Machinery, Motor-Driven.
Hayward Co.

Experimental Apparatus.
Biddle, James G.
Leeds & Northrup Co.
Roller-Smith Co.

Fan Motors.
Adams-Bagnall Electric Co.
Century Elec. Co.
Crocker-Wheeler Co.
Doubleday-Hill Elec. Co.
Emerson Electric Mfg. Co.
General Elec. Co.
Robbins & Myers Co.
Sprague Electric Works.
Western Elec. Co.

Fans (Exhaust and Ventilating).
Adams-Bagnall Electric Co.
Crocker-Wheeler Co.
Emerson Elec. Co.
General Elec. Co.
Green Fuel Economizer Co.
Kimble Elec. Co.
Mechanical Appliance Co.
Robbins & Myers Co.
Sprague Electric Works.
Westinghouse Elec. & Mfg. Co.

Fans, Turbine Driven.
Terry Steam Turbine Co.

Fault Finders, Cable.
Matthews & Bro., Inc., W. N.

Fibre.
American Vul. Fibre Co.
Continental Fibre Co.
Diamond State Fibre Co.
Fibre Conduit Co.
Spaulding & Sons Co., J.

Filters, Oil.
Richardson-Phenix Co.

Financial.
Coal & Iron National Bank.

Fire Extinguishers.
Johns-Maville Co., H. W.

Fixtures, Electric and Gas.
Adams-Bagnall Electric Co.

Flashers.
Campbell Electric Co.

WHAT AND WHERE TO BUY

Fuses.
Chicago Fuse Mfg. Co.
Condit Electrical Mfg. Co.
D & W Fuse Co.
Daum, A. F.
Economy Fuse & Mfg. Co.
Electric Fuseguard Co.
General Electric Co.
Metropolitan Eng'g Co.
Multi-Refillable Fuse Co.
Ry. & Industrial Eng'g Co.
Schweitzer & Conrad, Inc.
Western Elec. Co.

Fuses, Refillable.
Daum, A. F.
Economy Fuse & Mfg. Co.
Electric Fuseguard Co.
Multi-Refillable Fuse Co.

Gauges, Recording.
Bristol Co.
Foxboro Co., The.

Gears.
General Elec. Co.
New Process Gear Corp.

Gears, Herringbone.
Poole Eng'g & Mach. Co.

Gears, Reduction.
Poole Eng'g & Mach. Co.

Globes, Shades, Etc.
Adams-Bagnall Electric Co.

Grounds, Etc.
Paragon Elec. Co.

Guards, Incandescent Lamp.
Hubbell, Inc., Harvey.
Matthews & Bro., Inc., W. N.

Hair Driers.
Shelton Elec. Co.

Hangers, Cable.
Condit Electrical Mfg. Co.
Hubbard & Co.

Head Gates.
American Bridge Co.

Heaters, Feed Water.
National Pipe Bending Co.

Heating Devices, Electric.
Amer. Ironing Mach. Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Heating, Steam.
American District Steam Co.

Hoists, Electrical and Steam.
Allis-Chalmers Mfg. Co.
Maris Bros.
Sprague Electric Works.

Igniters, Gas Engine.
Carlisle & Finch Co.

Indicators, Sight Flow.
Richardson-Phenix Co.

Indicators, Speed.
Biddle, James G.
Roller-Smith Co.

Industrial Railways.
Easton Car & Const. Co.
Hunt Co., Inc., C. W.

Instrument Transformers.
General Elec. Co.
Weston Electrical Instr. Co.

Instruments, Electrical.
Graphic.
Biddle, James G.
Bristol Co.
General Electric Co.
Sangamo Elec. Co.
Westinghouse Elec. & Mfg. Co.
Indicating.
General Electric Co.
Roller-Smith Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Inst. Co.
Integrating.
Biddle, James G.
Duncan Electric & Mfg. Co.
General Electric Co
Roller-Smith Co.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
Scientific and Testing.
Biddle, James G.
General Electric Co.
Leeds & Northrup Co.
Metropolitan Eng'g Co.
Roller-Smith Co.

Insulating Machinery.
American Ins. Machinery Co.
New England Butt Co.

Insulating Material.
China and Porcelain.
General Elec. Co.
Imperial Porcelain Works.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.
Ohio Brass Co.
Parker & Son, J. H.
Pittsburgh H. V. Ins. Co.
Thomas & Sons Co., R.
Compounds, Paints and Varnishes.
Diamond State Fibre Co.
General Electric Co.
Garfield Mfg. Co.
Irvington Varnish & Ins. Co.
Redmanol Chemical Products Co.
Sherwin-Williams Co.
Composition, Cloth and Paper.
Diamond State Fibre Co.
Irvington Varnish & Ins. Co.
Mitchell-Rand Mfg. Co.
Fibre.
Amer. Vulcanized Fibre Co.
Continental Fibre Co.
Diamond State Fibre Co.
Spaulding & Sons Co., J.
Lava.
Steward Mfg. Co., D. M.
Mica.
Munsell & Co., Eugene.
Silk.
Irvington Varnish & Ins. Co.
Ryle & Co., Wm.
Tape.
Diamond State Fibre Co.
Freydberg Bros.
Mitchell-Rand Mfg. Co.
Packard Elec. Co., The.
Standard Woven Fabric Co.

Insulating Paper.
Diamond State Fibre Co.
Irvington Varnish & Ins. Co.

Insulators.
China, Porcelain and Composition.
Imperial Porcelain Works.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.
Ohio Brass Co.
Pittsburgh High Volt Ins. Co.
Thomas & Sons Co., R.
Glass.
Brookfield Glass Co.
Hemingray Glass Co.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.

Insulator Pins.
Elec'l Engineers Equipment Co.
Hubbard & Co.
Thomas & Sons Co., R.

Ironing Machines, Elec.
Amer. Ironing Mach. Co.

Lamp Guards.
Matthews & Bro., Inc., W. N.

Lamp-Hangers, Disconnecting.
Thompson Elec. Co.

Lamp Replacers.
Matthews & Bro., Inc., W. N.

Lamps, Arc.
Adams-Bagnall Electric Co.
Doubleday-Hill Elec. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Flaming Arc.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Incandescent.
Chicago Elec. Lamp Co.
Consolidated Elec. Lamp Co.
Doubleday-Hill Elec. Co.
Franklin Elec. & Mfg. Co.
General Electric Co.
Hygrade Lamp Co.
Independent Lamp & Wire Co.
Lux Mfg. Co.
National Lamp Works.
Triumph Lamp Works.
Western Elec. Co.
Westinghouse Lamp Co.

Lamps, Miniature.
General Electric Co.

Lava.
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Lightning Arresters.
Delta Star Elec. Co.
General Electric Co.
Hubbard & Co.
Ry. & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Line Material.
Anderson Mfg. Co., A. & J. M.
Archbold-Brady Co.
Clark Elec. & Mfg. Co.
Elec'l Engineers Equipment Co.
General Electric Co.
Hubbard & Co.
Ohio Brass Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Linemen's Tools.
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Linemen's Shields.
Matthews & Bro., Inc., W. N.

Lubrication Engineers.
Richardson-Phenix Co.

Lubricating Oils.
Texas Co.

Lubricators.
Richardson-Phenix Co.

Machines, Armature Notching.
Ferracute Machine Co.

Machines, Calculating.
Marchant Calculating Mach. Co.

Magnet Wire.
Acme Wire Co.
American Brass Co.
American Electrical Works.
American Steel & Wire Co.
Ansonia Elec. Co.
Belden Mfg. Co.
Benedict & Burnham Mfg. Co.
D & W Fuse Co.
General Electric Co.
Hazard Mfg. Co.
Independent Lamp & Wire Co.
Massachusetts Elec. Mfg. Co.
Roebling's Sons Co., J. A.
Rome Wire Co.
Western Elec. Co.

Magnets.
Acme Wire Co.

Magnets, Lifting.
Cutler-Hammer Mfg. Co.
Elec. Controller & Mfg. Co.

Mechanical Stokers.
American Engineering Co.
Riley Stoker Co., Ltd., Sanford.

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Manhattan Electrical Supply Co.

Meters, Flow.
General Elec. Co.
Spray Engineering Co.

Meter Testers.
States Company.

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Munsell & Co., Eugene.

Mining Machinery.
Allis-Chalmers Mfg. Co.
Crocker-Wheeler Co.

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Hemming Mfg. Co.

Molding, Metal.
National Metal Molding Co.

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Klein & Sons, Mathias.

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Carlisle & Finch Co.

Nozzles, Spray.
American Spray Co.
Spray Engineering Co.

Oiling Systems, Cutting.
Richardson-Phenix Co.

Oiling Systems, Hydro-electric.
Richardson-Phenix Co.

Oiling Systems, Sight Feed
Richardson-Phenix Co.

Oiling Systems, Turbine.
Richardson-Phenix Co.

Oil, Lubricating.
Texas Co.

Oil, Transformer.
Texas Co.

Oils, Cylinder.
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Oilers, Telescopic.
Richardson-Phenix Co.

Panel Boards.
Adams-Bagnall Electric Co.
General Electric Co.
Trumbull Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.

Penstock.
Portland Wood Pipe Co.

Photometric Apparatus.
Elec'l Testing Laboratories.
Leeds & Northrup Co.

Pinions, Rawhide.
New Process Gear Corp.

Pipe, Steel.
National Tube Co.

Pipe, Wood.
National Tank & Pipe Co.
Portland Wood Pipe Co.
Washington Pipe & Foundry Co.

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Pipe (Riveted Steel).
Washington Pipe & Foundry Co.

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Western Elec. Co.

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Poles, Reinforcing.
Hubbard & Co.

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Coombs, R. D.
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Okonite Co., The.

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General Electric Co.
Metropolitan Engineering Co.
Schweitzer & Conrad, Inc.
Wadsworth Elec. Mfg. Co.

Pumps, Air.
Worthington P. & M. Corp.

Pumps, Centrifugal.
Allis-Chalmers Mfg. Co.
Terry Steam Turbine Co.

Pumps, Oil.
Richardson-Phenix Co.
Worthington P. & M. Corp.

Pumps, Steam Driven.
Allis-Chalmers Mfg. Co.
Terry Steam Turbine Co.
Worthington P. & M. Corp.

Pumps, Vacuum.
Worthington P. & M. Corp.

Pumps, Water Works.
Terry Steam Turbine Co.

Push Buttons.
Manhattan Electrical Supply Co.

Pyrometers.
Bristol Co., The.
Leeds & Northrup Co.

Rail Bonds.
American Steel & Wire Co.
Condit Electrical Mfg. Co.
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Railways, Miniature.
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General Electric Co.

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Rectifiers.
General Electric Co.

Reflectors.
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General Electric Co.

Repairing.
Gregory Electric Co.
Nelson, I. R.

Resistance Units.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Ward Leonard Electric Co.

Resistance Wire. (See Wires, Resistance.)

Rheostats.
Biddle, James G.
Campbell Electric Co.
Crocker-Wheeler Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Elec. Co.
Industrial Controller Co.
Monitor Controller Co.
Sundh Electric Co.
Ward Leonard Electric Co.

Rosettes.
General Electric Co.
Hart Mfg. Co.
National Metal Molding Co.

Searchlights.
Carlisle & Finch Co.
General Electric Co.

Second-hand Apparatus.
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Andrén, Karl.
Archer & Baldwin.
Baldwin Co., R. S.
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Brown Hunkele Corp.
Carey, Philip.
De Forest Radio Co.
Duquesne Elec. & Mfg. Co.
Elliott Elec. Co.
Freeman & Co., T.
Fuerst-Friedman Co.
Gen. Ry. Signal Co.
Glen Eyrie Devel. Co.
Gregory Electric Co.
Harris Bros.
Indep. Elec. Machy. Co.
Kirchner Co., H. J.
Klein & Co., Nathan.
MacGovern & Co.
McCoy Brandt Machy. Co.
Miami Copper Co.
Milwaukee Elec. Ry. & Light Co.
Morse Bros. Machy. Co.
Myerson, Joseph.
Nat'l Machy. & Wreck. Co.
National Products Co.
Nelson, I. R.
Obrien Machy. Co.
Partridge, A. S.
Phillips, Leo. A.
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Reliance Equipment Co.
Ridlon Co., Frank.
Ross Power & Equipment Co.
Salzberg Co.
Sachsenmaier & Co., Geo.
Scheinert Co., R.
Schwartz & Land.
Standard Elec. & Elevator Co.
Steam & Elec. Machy. Co.
Stewart, Paul.
Tiffany, Hall & Co., Inc.

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Cutler-Hammer Mfg. Co.

Shade Holders.
Adams-Bagnall Electric Co.
General Electric Co.
Hubbell, Inc., Harvey.

Sheet Metal.
Am. Sheet & Tin Plate Co.

Sheets, Electrical.
Am. Sheet & Tin Plate Co.

Sleeves, Splicing.
Elec'l Engineers Equipment Co.

Sockets and Receptacles.
Benjamin Elec. Mfg. Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hart Mfg. Co.
Hubbell, Inc., Harvey.
National Metal Molding Co.

Sockets, Turndown.
General Electric Co.

Soldering Flux.
Allen Co., Inc., L. B.
Blake Signal & Mfg. Co.
Condit Electrical Mfg. Co.

Soldering Irons.
Cutler-Hammer Mfg. Co.
General Electric Co.

Soldering Outfits, Acetylene.
Prest-O-Lite Co., Inc.

Solenoids.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Ward Leonard Electric Co.

Special Machinery.
Torrington Mfg. Co.

Splicing Sleeves.
Clark Elec. & Mfg. Co.
Frankel Connector Co., Inc.

Springs.
American Steel & Wire Co.
Cary Spring Works.
Cook Spring Co.

Stacks, Steel, Smoke.
American Bridge Co.

Stage Lighting Apparatus.
Campbell Electric Co.
Condit Electrical Mfg. Co.

Staples.
American Steel & Wire Co.
Blake Signal & Mfg. Co.

Starters, Motor.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Sundh Elec. Co.
Ward Leonard Electric Co.

Stokers.
American Engineering Co.
Edge Moor Iron Co.
Green Eng'g Co.
Riley Stoker Co., Sanford.

Stoves, Elec. (See Ranges, Elec.)

Strainers, Water.
American Spray Co.

Sub-Stations, Outdoor.
Delta Star Elec. Co.
General Electric Co.
Railway & Industrial Eng. Co.
Transmission Eng'g Co.

Supplies (Electric Railway).
General Electric Co.
Johns-Manville Co., H. W.
Ohio Brass Co.
Western Elec. Co.

Supplies, Electrical.
British Thomson-Houston Co., Ltd.
Dick, Kerr & Co., Ltd.
General Electric Co.
Gen. Elec. Co., Ltd., of G. B.
Manhattan Elect. Supply Co.
Western Elec. Co.

Switchboard Supplies.
Condit Electrical Mfg. Co.
Elec'l Engineers Equipment Co.
General Electric Co.
Johns-Manville Co., H. W.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.

Switchboards.
Allis-Chalmers Mfg. Co.
Anderson Mfg. Co., A. & J. M.
Condit Electrical Mfg. Co.
General Electric Co.
Roller-Smith Co.
Triumph Elec. Co.
Trumbull Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

Switches, Automatic Time.
Anderson Mfg. Co., A. & J. M.
General Elec. Co.
Matthews & Bro., Inc., W. N.

Switches, Disconnecting.
Anderson Mfg. Co., A. & J. M.
Elec'l Engineers Equipment Co.
Fisher-Chase Mfg. Co.
General Elec. Co.
Matthews & Bro., Inc., W. N.

Switches, Enclosed.
Palmer Elec. Mfg. Co.

Switches, Float.
Cutler-Hammer Mfg. Co.
General Elec. Co.
Sundh Elec. Co.

Switches, Fuse.
Fisher-Chase Mfg. Co.
General Electric Co.
Matthews & Bro., Inc., W. N.

Switches, Knife.
Anderson Mfg. Co., A. & J. M.
Condit Electrical Mfg. Co.
Cutter Co., The.
Detroit Fuse & Mfg. Co.
Electric Controller & Mfg. Co.
Elec'l Engineers Equipment Co.
General Electric Co.
Metropolitan Eng'g Co.
Trumbull Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Worcester Elec. & Mfg. Co.

Switches, Oil.
Condit Electrical Mfg. Co.
General Electric Co.
Park Royal Engrg. Wks., Ltd.
Westinghouse Elec. & Mfg. Co.

Switches, Pole Top.
Delta-Star Elec. Co.
Elec'l Engineers Equipment Co.
General Electric Co.
Ry. & Industrial Eng'g Co.

Switches, Remote Control.
Anderson Mfg. Co., A. & J. M.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hart Mfg. Co.
Sundh Elec. Co.

Switches, Series.
General Elec. Co.

Switches, Snap and Push Button.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hart Mfg. Co.
Trumbull Elec. Mfg. Co.

Switches, Time.
Campbell Electric Co.
General Elec. Co.
Hartford Time Switch Co.
Paragon Electric Co.
Matthews & Bro., Inc., W. N.

Tachometers.
Biddle, James G.
Bristol Co., The.
Foxboro Co., The.
Roller-Smith Co.

Taps and Dies.
Carpenter Tap & Die Co., J. M.

Telephone Service.
American Tel. & Tel. Co.

Telephones.
Manhattan Elec'l Supply Co.
Western Elec. Co.

Testing Apparatus.
American Transformer Co.
Biddle, James G.
Leeds & Northrup Co.
Roller-Smith Co.

Testing Laboratories.
Elect. Testing Laboratories.
Leeds & Northrup Co.

Theatre Dimmers.
Cutler-Hammer Mfg. Co.
General Electric Co.
Industrial Controller Co.
Ward Leonard Electric Co.

Thermometers.
Bristol Co., The.
Foxboro Co., The.
Leeds & Northrup Co.

Thermostatic Metal.
Wilson Co., H. A.

Tools, Construction.
Klein & Sons, Mathias.

Tools, Linemen's.
Klein & Sons, Mathias.
Western Elec. Co.

Tools, Portable Elec.
Chicago Pneumatic Tool Co.

Tools, Underground Conduit.
Cope, T. J.

Towers, Transmission.
American Bridge Co.
Archbold-Brady Co.
Bates Exp. Steel Truss Co.
Blaw-Knox Co.
Coombs, R. D.
Railway & Industrial Eng. Co.
Transmission Eng'g Co.

Transformers.
Adams-Bagnall Elec. Co.
Allis-Chalmers Mfg. Co.
American Transformer Co.
Campbell Electric Co.
Crocker-Wheeler Co.
Duncan Elec. Mfg. Co.
Enterprise Electric Co.
General Electric Co.
Kuhlman Elec. Co.
Metropolitan Eng'g Co.
Moloney Elec. Co.
Pittsburgh Transformer Co.
Thordarson Elec. Mfg. Co.
Triumph Elec. Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Ins. Co.

Transformers, Bell Ringing
General Electric Co.
Pittsburgh Transformer Co.
Westinghouse Elec. & Mfg. Co.

Truck, Industrial Ry.
Easton Car & Const. Co.

Turbines, Steam.
Allis-Chalmers Mfg. Co.
British Thomson-Houston Co., Ltd.
General Electric Co.
Ridgway Dynamo & Eng. Co.
Terry Steam Turbine Co.

Turbo-generators.
Terry Steam Turbine Co.

Vacuum Cleaners.
Western Elec. Co.

Valve Discs.
Diamond State Fibre Co.
Ohio Brass Co.

Valves.
Ohio Brass Co.
Richardson-Phenix Co.

Valves, Superheated Steam.
Richardson-Phenix Co.

Vehicles, Electric.
General Vehicle Co., Inc.

Vibrators.
Shelton Elec. Co.
Thordarson Elec. Mfg. Co.

Washing Machines, Electric.
Western Elec. Co.

Water Wheels and Turbines.
Allis-Chalmers Mfg. Co.
Leffel & Co., James.
Smith Co., S. Morgan.
Trump Mfg. Co.

Water Wheel Governors.
Lombard Governor Co.
Woodward Governor Co.

Waterproofing.
Mitchell-Rand Mfg. Co.

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Lincoln Electric Co.

Weatherproof Wire.
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Roebling's Sons Co., J. A.

Winding Machines.
New England Butt Co.

Wire, Copper Clad.
Page Steel & Wire Co.

Wire, Rubber Covered.
Roebling's Sons Co., John A.
Ward & Goldstone, Ltd.

Wires, Resistance.
Driver-Harris Wire Co.
Electrical Alloy Co.

Wires and Cables.
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Acme Wire Co.
Amer. Brass Co.
Amer. Electrical Works.
Amer. Steel & Wire Co.
Ansonia Elec. Co.
Atlantic Ins. Wire & Cable Co.
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Benedict & Burnham Mfg. Co.
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Hazard Mfg. Co.
Independent Lamp & Wire Co.
Indiana Rub. & Ins. Wire Co.
Kerite Ins. Wire & Cable Co.
Lowell Ins. Wire Co.
Massachusetts Elec. Mfg. Co.
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Rome Wire Co.
Safety Ins. Wire & Cable Co.
Simplex Wire & Cable Co.
Trumbull Elec. Mfg. Co.
Western Elec. Co.

Wood, Pipe.
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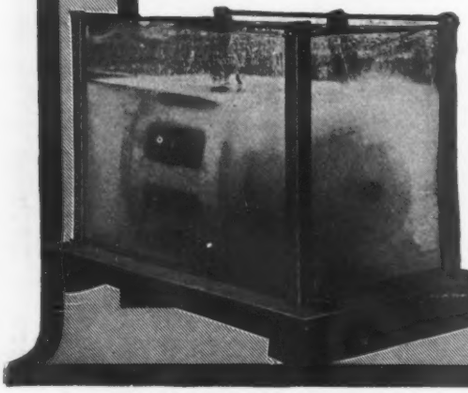

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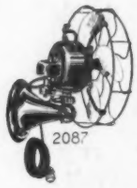

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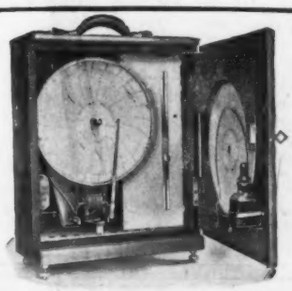
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